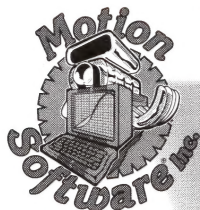# X CAR ®

PROFESSIONAL
ROAD RACING

Developed By Bethesda Softworks™

XCAR PRO-PACK
INSTALLATION
AND USER GUIDE

Compatible With Motion-PC® & DeskTop Dyno Simulation Technology

MOTION-PC®
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Motion Software, Inc.
535 West Lambert Road, Building
Brea, California 92821-3911
Voice: 714-255-2931, Fax: 714-255-7956
Web: www.motionsoftware.com
Email: support@motionsoftware.com

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CONTENTS

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PROFESSIONAL

INTRODUCTION

XCar Pro Package Overview

Thank you for purchasing XCar™ Pro, the most realistic and exciting road-racing game ever developed for the PC. XCar Pro incorporates the most elaborate real-world physics simulations ever used in a PC "game." This comprehensive modeling ensures that XCar Pro will accurately simulate the thrill of racing on high-speed ovals, wide-open country roads, mountain highways, and even city streets.

XCar Pro is the collaborative effort of two companies: Motion Software™ and Bethesda Softworks™. If you are familiar with PC gaming, you undoubtedly know Bethesda Softworks as one of the most innovative and creative game developers. Their Elder Scrolls™ and Terminator™ series, plus Wayne Gretzky Hockey™ are just a few of their incredibly successful products. But recently they've turned their considerable talents toward the racing enthusiast. XCar Pro is the result of over 30-person-years of work. It not only breaks new ground in driving realism, but allows you to modify virtually every vehicle component to test and optimize engine and chassis configurations. It is even possible to build engines in Motion Software's Dyno simulations and import and race them in XCar Pro. There is no other driving simulation on the planet that gives you such tuning and modification capability.

A less-comprehensive version of XCar, designed specifically for the PC gamer rather than the auto enthusiast, was originally produced and sold by Bethesda late in 1997. But after some modifications by both Bethesda and Motion Software, XCar was transformed into XCar Pro, a product built specifically for you: The automotive enthusiast. If you're looking for the ultimate in simulation accuracy and tuning capability, we're confident that XCar Pro will more than meet your expectations.

The XCar Pro-Pack

XCar Pro is made up of the XCar driving simulation, enhanced as described previously. In addition, several added features have been included that will optimize your simulation and driving experiences. Here are the major Pro-Pack features:

- Software and Hardware Accelerated versions using X^{n}gine® technology that produces the fastest action of any real-world driving simulation
- Special XCar Pro Engine Editor lets you modify engine power curves, and...
- Imports Mr. Gasket DeskTop Dyno and Motion-PC Dyno Shop engine simulation files
- Extra Pro-Pack vehicles
- Incredible XCar Pro Paint Shop to customize the look of any vehicle
- XCar Pro Tire Editor allows you to experiment with tire design
- Also includes Mr. Gasket DeskTop Software Demo Video (*Build'em, Test'em, Perfect'em, Race'em*) that you can view on your PC

Minimum System Requirements:

Before installing XCar Pro, make sure your system meets the minimum requirements. Systems that do not have at least

Introduction To XCar Pro

the following capabilities will not be able to run this comprehensive vehicle-dynamics simulation to its full potential.

- IBM™ Compatible PC Pentium-90
- 16MB Ram Memory
- Basic VGA Video Graphics Card with a VESA-compatible video software driver
- Sound Blaster compatible sound card
- 5MB free hard disk space (for minimum install; 50MB recommended)
- Double-Speed CD-ROM drive
- MS-DOS version 5.0+
- Mouse (joystick or steering wheel with pedals recommended)
- Support provided for 3Dfx (Voodoo) hardware graphics acceleration

Getting The Most From XCar Pro

XCar Pro is composed of two distinct simulations. The first, just discussed, allows you to tune and modify virtually every engine and chassis component. And in this simulation category you need little more than your computer, XCar Pro, and some imagination and careful analysis. It is easy to spend tens if not hundreds of hours trying and testing various component combinations.

However the second category—the driving simulation—can only be fully appreciated with the right PC hardware. You'll have fun racing XCar Pro with a joystick (or even a keyboard), but in order to get a feel for the incredible accuracy and "stomach-flipping" sensations that XCar Pro can generate, you'll need a quality steering wheel and pedal set for your PC.

Steering wheel sets are really joysticks in disguise and can be installed in only minutes (your PC must have a game port to use a joystick or steering-wheel/pedal-set). XCar works with most steering-wheels. However, the Nascar™ Pro Wheel/Pedal set by Thrustmaster™ was used by play testers during the development of XCar Pro, and we were very satisfied with its performance (it's available in computer stores and it can be purchased on Motion

Software's web site: www.motionsoftware.com). A steering wheel and pedals will usually cost from $60 to about $150. If you use XCar Pro with a quality steering wheel, you'll be amazed at the difference in "feel" over a joystick.

Obtaining Technical Support

XCar Pro has been tested on many systems and with many combinations of video-graphics cards, operating systems, and software configurations. It has been designed to operate properly on a wide variety hardware/software platforms (refer to the list of compatible hardware found in the Read.me file on the XCar Pro CD-ROM). However, it is possible that you may encounter installation or operational problems, since virtually every PC is unique in some way. Our testing has indicated that XCar Pro problems can be solved in over 90% of cases by reviewing and applying the information in this guide. Please take a few minutes and look over the following sources of information before you contact technical support:

- The FAQs in this booklet on page 49 contain detail installation and operational questions and answers. Also review the Installation and Options chapters for help with calibrating joysticks and steering-wheels/pedal-sets, for using XCar Pro menus, and for driving tips.
- Visit the Tech Support section of the Motion Software website for additional tips and FAQs.

If you cannot find a solution to your problem, use the fax-back form in this manual on page 55. Fax or mail the completed form to:

Motion Software, Inc.
535 West Lambert, Bldg. E
Brea, CA 92821-3911
Tech Fax: 714-255-7956, or visit our
Web: www.motionsoftware.com
Email: support@motionsoftware.com

Tech support will only be provided to registered users. Please send in your registration card today.

XCAR PROFESSIONAL

INSTALLATION

Installing XCar Pro

The installation program included with XCar Pro will copy the appropriate files to your hard drive and configure music- and sound-effects drivers for your sound card.

When XCar Pro has been installed and is started for the first time, you'll see a joystick calibration screen that will help you configure your joystick or steering-wheel/pedal-set for optimum driving control. Please read each of the following instructions carefully.

1) Insert the XCar Pro CD-ROM into your CD drive.

2) If you are running Windows95 or later, a installation/run screen will appear on your desktop within 5 to 30 seconds (depending on the speed of your CD drive). Click INSTALL to begin the installation program; proceed to step 4.

3) If the XCar installation screen does not automatically display, run **INSTALL** on the XCar Pro CD-ROM. (Switch to your CD Drive by typing the CD Drive letter at the DOS prompt [e.g., **E:**], then type INSTALL and press Enter.)

4) The first INSTALL screen will allow you to review the on-disk **Read.me** file or proceed with the installation. Since most of the information in the read.me file is contained in this QuickStart guide, click on **Install XCar** to proceed.
Note: If your mouse does not work in the installation program, you should review the information on page 49 so that your mouse will function during installation and within XCar Pro (not required, but helpful).

5) The second and subsequent installation screens will give you the option to install different sizes and versions of XCar Pro.
CAREFULLY READ AND FOLLOW THE ON-SCREEN INSTRUCTIONS.

Note: You may install two small versions of XCar Pro (5MB and 11MB that save disk space, but run somewhat slower) or you can install the complete software package (57MB, runs fastest). In addition, you are given the option to install either the standard "Software Versions" (just described) or a 3Dfx "Hardware Accelerated" version of XCar Pro. **Only install the 3Dfx version if your computer is equipped with a 3Dfx (Voodoo) video accelerator card** (available from many computer stores and it may be purchased in the GAMES section of Motion Software's website (www.motionsoftware.com). Both software and hardware-accelerated versions are functionally identical, however, the 3Dfx version will display graphics, track action, and passing scenery more quickly.

6) Click on **Change Install Size** to view the install options. When you have selected the appropriate program size and version, review the installation path (defaults to C:\XCAR). Change the location, if desired, then select **Go Ahead...** to complete the installation. When the main installation is complete, choose **YES** when requested to perform sound-

card setup.

7) If the sound-card setup program does not automatically begin, switch to the drive onto which you installed XCar Pro. Then run **SETUP** that is located in the XCar directory (type SETUP and press Enter). The sound setup routine can be rerun at any time by repeating this procedure or reinstalling XCar Pro from the CD-ROM.

8) If you have problems during sound setup (the program won't recognize your sound card or your system locks up), rerun SETUP and try selecting the basic Sound Blaster card for both digital and MIDI. If you still have problems, refer to the FAQs on page 49.

Starting XCar Pro The First Time

9) Make sure the XCar Pro CD is in the CD Drive (the program will not run unless the XCar Pro CD-ROM is installed in your CD Drive). Make sure your joystick or steering-wheel/pedal-set is plugged into your game port.

10) If you are running Windows95 or later, click on **RUN** when the XCar Start window is displayed.

11) If you do not see the XCar Start window, switch to the drive onto which you installed XCar Pro. In the XCAR directory, run XCAR.EXE (or XCARFX.EXE if you installed the 3Dfx version) directly by typing XCAR and pressing Enter (or double clicking on XCAR.EXE).

12) When the game begins for the first time, you will see the joystick calibration screen (see the next chapter for more information about joystick and keyboard controls). As instructed, move the joystick throughout the full extent of its motion, then press one of the joystick buttons. In the next screen you can set a variety of options for XCar Pro. You can assign a joystick button or keyboard key to each of the displayed functions. For example, to have the number 1 joystick button (usually the "trigger") cause XCar Pro to shift to the next higher gear, use the arrow keys to move down to SHIFT-UP, then press the #1 joystick button once to activate SHIFT-UP programming, then a second time to assign the #1 button.

13) Please review the following chapters in this QuickStart guide for more information on menu selections, program functions, and driving tips.

14) If you have problems with XCar, Please take a few minutes and look over the following sources of information before you contact technical support:
 • The FAQs in this booklet on page 49 contain detail installation and operational questions and answers.
 • The Getting Started chapter (next) in this manual will help you calibrate joysticks and steering-wheels/pedal-sets and help you use XCar Pro menus.
 • Visit the Tech Support section of the Motion Software website for additional tips and FAQs.

If you cannot find a solution to your problem, use the fax-back form in this manual on page 55. Fax or mail the completed form to:

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XCR

GETTING STARTED

The sport of high-speed racing has always stirred souls and fired imaginations. Stock cars, sprint cars and open-wheel racers all embody their own special brand of excitement. Nothing compares to the exotic vehicles in XCar Pro: The next-generation sports prototype supercars. Welcome to the fast action and technical detail of XCar Professional Road Racing.

Arguably the most scientific sport there is, racing technology is especially intriguing. The degree of intensive science and technology used in a world class racing project is amazing. To some, racing is simply engineering formulas and theoretical physics; others interpret the sport as a study in mechanics; still others regard it as a pure art form. All agree that racing is an adrenaline rush.

Information about leading-edge prototype technology is very difficult to obtain. Race teams and component manufacturers are understandably secretive about their advancements. Most agreed to provide information only if they were kept anonymous. In XCar Pro, the player may construct a car using various technologies, and observe the results on the track. The player may modify and tailor the setup for optimal performance on any given track.

Because XCar profiles technology, rather than a specific racing league, we chose to simulate a class of cars referred to as "sports prototype." Typically closed-cockpit, closed-wheeled designs, these cars are basically unlimited in configuration. Since there is no racing organization to define a set of governing rules, XCar Pro has its own, borrowing from the best of several existing organizations.

This manual will help you get the most out of XCar Pro and uses the following conventions:

Bold—items refer to important items or items that require user input.

Bold Italic—items refer to menu screens or menu items.

The term "Select" or "Click on" refers to one of the following:

Mouse—Move the mouse pointer over the item and press the left button.

Joystick—Move the joystick up or down until the item is highlighted, then press a button to make the selection.

Keyboard—Use the **Cursor Up** or **Cursor Down** "arrow" keys until the item is highlighted and then press the **ENTER** key.

USING GAME CONTROLS

Calibrating the Joystick

The joystick must be calibrated before it can be used. When XCar is started for the first time and a joystick is detected, you will automatically be asked to calibrate your joystick. After the first calibration session, there is no need to re-calibrate unless your joystick goes out of calibration or you switch joysticks.

To calibrate a joystick, select ***Options*** from the ***Main Menu*** and select ***Calibrate Joysticks***. Move your joystick(s) to their limits then release the handle to allow it to return to the default, center position, then press a button. The calibration is automati-

Joystick Calibration & Setting Controls

cally saved and will be loaded the next time you play. If you change joysticks or experience problems with a joystick, press the **R** key at the *Calibrate Screen* to reset the calibration. Then re-calibrate your joystick. During game play it is not uncommon for a joystick to "drift" off center. Most joysticks have an adjustment wheel or slider to correct this, but you can press the **F2** key when the joystick is centered to reset the joystick center location.

Menu Controls

When selecting menu items outside of the driving simulation, the active menu controls are shown in **Table–1**.

Game-Play Controls

While menu-selection controls are fixed, vehicle and game-play controls are fully customizable. If a joystick is detected, the default controls will be joystick-based, otherwise keyboard controls will be selected, even though a mouse may be present.

The default game-play controls are

Table 1—Active Menu Controls

Action	Keyboard	Joystick	Mouse
Change Highlighted Item	Up/Down Arrow	Joy A Y Axis	Position cursor and press left button
Toggle/execute option	ENTER key	Button	Left button press
Previous screen	ESC key	ESC key	Right button press

Table 2—Default Game Controls

Action	Keyboard	Joystick
Accelerate	Cursor up	Joystick forward
Brake	Cursor down	Joystick backward
HUD toggle	Space bar	Button B
Look left	S key	S key
Look right	F key	F key
Look forward	E key	E key
Look back	D key	D key
Next view	> key	> key
Previous view	< key	< key
Reverse	R key	Button A
Shift up	A key	A key
Shift down	Z key	Z key
Steer left/right	Cursor left/right	Joystick left/right

Default Keyboard Controls

Shift Up — Reverse — Shift Down — Previous View — Steer Left — Next View — Accelerate — Brake — Steer Right
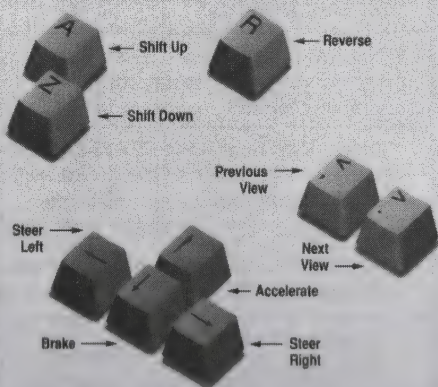
Customizing Game-Play Controls

Default Joystick Controls

Reverse
HUD Toggle
Steer Left
Accelerate
Brake
Steer Right
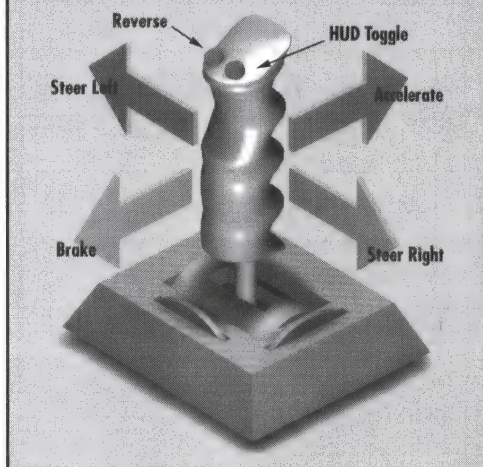
shown in **Table-2** and on this page.

Customizing Controls

Before racing you should customize the game-play controls to suit your personal preferences. You need only do this once. XCar will automatically save and reload the control settings each time you run the game.

To customize the controls, select **Options** from the Main Menu and then **Set Controls**. Move to the control you wish to change and press **ENTER**. Press the key/button (or move the joystick to the desired direction) that you wish to assign the control function. The display will change showing the newly assigned control. Pressing **ESC** while assigning a control will cancel the operation.

The controls shown in **Table–3** cannot be customized and are always assigned to the specified keys.

NOTE: These fixed keys cannot be assigned to other functions and are disallowed while customizing controls.
* Captured screens are placed in the SAVE directory within the XCAR install directory on your hard disk.

Table 3—Fixed Game Controls

Action	Key
Map on/off	TAB key
Reorient (One-Time Quick Spin help)	F1 key
Re-center joystick	F2 key
Metric/US units	F3 key
HUD on/off	F4 key
Pause game	F5 key
Side view mirrors on/off	F6 key
Spin help on/off	F7 key
Steering help on/off	F8 key
Auto-braking on/off	F9 key
Race line on/off	F10 key
Zoom map in	+ key
Zoom map out	- key
Begin/reset telemetry	0 key
Front roll arm softer	1 key
Front roll arm stiffer	2 key
Rear roll arm softer	3 key
Rear roll arm stiffer	4 key
Decrease steer ratio	O key
Increase steer ratio	P key
Move HUD left	Q key
Move HUD right	W key
Take a screen shot*	INS key
Decrease steer lock	[key
Increase steer lock	] key
Disable 3-D view (Main Select only)	DEL key
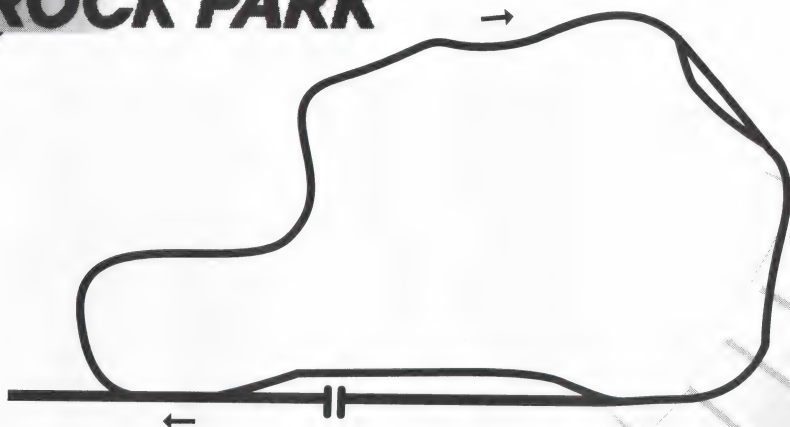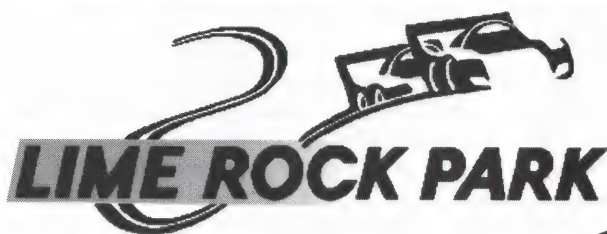
LIME ROCK PARK

If you want to dive into XCar Pro and race, here's the information you need to take a quick lap around Lime Rock Park.

Begin from the *Main Menu* screen, and choose *Select Car*. Choose a car that's to your liking by using the Cursor Arrow Keys. Type a new name for the car or keep the existing one by simply pressing *Enter*. You will then return to the *Main Menu*.

Select *Quick Race* for the fastest way to the racetrack. Choose *Lime Rock* from the list of tracks. Soon you will find yourself in the cockpit of your car. You will be forced to start near the back of the pack since you didn't make a qualifying run (qualifying and other advanced features are explained later in this manual). Press the *Tab* key to turn on the *Track Map*.

The lights will start a count–down. The race will start as soon as the light turns green. You may stop the race at any time by pressing the *ESC* key. Accelerate down the main stretch until you pass under the pedestrian bridge. Hit the brakes (see **Game Options** on page 17 for information on setting up automatic shifting and braking and other *Realism* features) and slow

to about 90 mph. The first turn is a large 180 degree turn and you should keep your car close to the inside of the turn.

When you exit the turn, accelerate briefly and then brake to about 70 mph. The next two turns combine into an "S" that leads gradually toward a sharp uphill turn. This turn can be taken at a slightly higher speed than expected because of the G-forces produced when climbing the hill tend to keep your car on the track. Now accelerate down the short straight and brake to about 80 mph for the next right-hander. Accelerate under the bridge and down the steep hill leading onto the front straight; this the fastest portion of the track. As you pass the start/finish line the pit board will display your time and position.

Using the HUD (Heads-Up Display)

One of the best advancements in racing instrumentation has been the Head-Up-Displays (HUD). The HUD displays instrument data as graphic information projected onto the driver's windshield or visor so that the driver never has to take his/her eyes off the road. Though the HUD will probably never replace the conventional analog gauges, it can display a variety of user-selectable information previously unavailable to the driver.

Heads-Up Display Functions
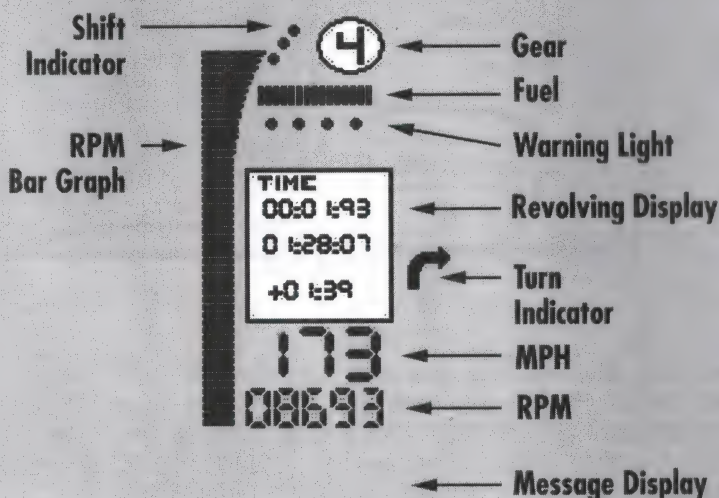
The HUD contains several fixed gauges that cannot be changed by the driver. These include:

Shift Indicator

Indicates when optimal shift points have been reached. The first indicator lights when the engine is operating at maximum fuel efficiency. The third indicator light represents that the engine has reached maximum torque. If you wish to conserve fuel, you should shift when the first indicator illuminates.

RPM Bar Graph

Shows a graphic representation of the current engine RPM.

RPM display

Displays a numeric value representing the current engine RPM.

MPH or KPH

Indicates the current speed in MPH or KPH (units are selectable by pressing the *F3* key).

Turn Indicator

The turn indicator will display the direction and degree of the approaching corner.

Warning Light

The warning lights indicate:
High Water temperature
Low Oil Pressure
Low Fuel
Low Battery Output

Using the HUD (Heads-Up Display)

Fuel Indicator

Displays a bar graph showing the amount of fuel remaining in the tank.

Gear Indicator

The gear indicator will display the current gear in which the transmission is engaged.

Message Display

The HUD will use this area to display telemetry messages from your pit and/or from your on-board systems.

Revolving Display

In addition to the fixed displays, there is a display that is driver-selectable. The display can show any of the following information:

TIME 00:01:93 01:28:07 +01:39	**Current, Previous Time & Time Difference**
SPLIT 000.0 +00.0 000.0	**Current Split, Split Difference & Best Time**

The driver can manually cycle through the gauges by using the HUD toggle control (see **Customizing Controls** on page 12).

The HUD is also capable of displaying an overhead map of the track. Your current position, as well as your opponents locations, are displayed. The map is always centered around your car. The map is toggled on and off by pressing the **TAB** key. The map can be scaled up or down using the + and − keys.

During network play, the HUD will display the name of each player above their car, allowing you to easily keep track of your opponents.

OIL TEMP. 94.0 WATER 175.0	**Oil Pressure & Water Temperature**
BATTERY 13.50 FUEL 5.60	**Battery Voltage & Fuel Usage**
BOOST 12.00 G-FORCE 2.30	**Boost Pressure & Lateral G-Force**
LAP 4 POSITION 6	**Current Lap & Position**

XCAR
PROFESSIONAL
GAME OPTIONS

The **Options** menus allow adjustment of the game to suit your particular tastes and skills. The default options provide high-quality display speed and a difficulty level geared to a rookie driver. As you become more proficient at XCar Pro, the options can be adjusted to provide a continuing challenge. The options menus are accessed by selecting **Options** from the **Main Menu** screen. After the initial run, all options are saved and automatically reloaded each time XCar is started.

Calibrate Joysticks
See section on calibrating joysticks on page 10.

Set Controls
See section on customizing controls on page 12.

Graphics Menu

The graphics options allow you to adjust the type and level of graphics used during a race. Turning these options on and off will affect the overall speed and look of the game. The following options are available:

Resolution
This is the screen resolution used during the actual race. You can select from 320x200, 640x480 or 800x600.
NOTE: In the 3Dfx hardware-accelerated version of the game (selected during installation), resolution is unchangeable.

Render Distance
This option adjusts how far in the distance objects are drawn on screen. The longer the distance, the more objects will appear.

Trees and Buildings
These options allow you to adjust the number of trees and buildings drawn. On the highest setting, all trees/buildings are drawn while the lower setting draws fewer trees/buildings (allowing the game to run faster).

Horizon
This option allows the textured horizon to be turned on or off.

Smoke/Dirt
This option allows the display of smoke and dirt to be turned on or off.

Road
This option allows the textures on the road to be turned on or off.

Grass
This option will turn on or off textures within the grass and dirt.

Walls
This option will turn wall textures on or off.

Other
This option allows the textures on buildings and other objects to be turned on or off.

Sound Menu

The sound options allow you to control the volume and types of sounds. The following options are available:

Setting Game Options

Music

Turns the playback of the "Redbook Audio" on or off (this is high-quality background music). Since XCar Pro only uses Redbook audio, it cannot control the output volume. If the music is too loud, the volume will need to be adjusted outside of XCar, usually in a mixer program supplied with your sound card or CD-ROM.

Opponents

Specifies the number of opponents heard during a race.

Engines

Adjusts the volume of the engines.

Skidding

Adjusts the volume of tire-skid sounds. It is not recommended that this option be turned off. The tire squealing sound provides important feedback on how the tires are gripping the road.

Pit Radio

Adjusts pit radio communications.

Crashes

Adjusts crash sounds.

Other Sounds

Adjusts the output volume for sound effects such as menu sounds and announcers.

Realism Menu

The *Realism* menu contains options for adjustment of how "realistic" the game play is. The following options are available:

Mode

Selects *Realistic* or *Action* mode. Action mode allows your car to grip and corner beyond what would normally be possible. It also automatically selects the Damage option *None*, allowing your car to bounce off walls without getting too far out of control. This mode is recommended for begin-

ning players

Race Length

Adjusts the duration of a race, as a percentage of the actual race length. The lower the percentage, the shorter the race.

Weather

Allows varied weather conditions to occur. If Weather is set to *Off*, the race day will always be sunny and dry.

Damage

Adjusts the level of damage sustained in a collision. *Realistic* damage will allow your car to take only a few hits before becoming disabled. *Minimize* will allow your car to take several more hits before becoming disabled. *None* will not allow your car to become disabled from accidents.

Wear

Allows wear on a car to influence car performance. Items that are affected by wear include the engine, brakes, and tires.

Spin Help

Enables or disables spin help. If *Spin Help* is *On*, it will point your car in the correct direction after a collision or spin out. During the game, *Spin Help* takes affect only after you come to a stop.

Opponents

Selects the number of opponents in the race. The more opponents, the more difficult the contest will be.

Skill Level

The skill level of the AI (Artificial Intelligence) opponents can be adjusted with this option. In *Rookie* level, the cars are much slower and tend to hold a steady line. In *Amateur* level, the cars are faster and more aggressive. In *Pro* level, the cars will always attempt to be at full speed and are very aggressive when passing.

Game Options/Improving Game Speed

Race Line
Turns the display of the ideal race line on and off. The race line appears as a light gray dashed line positioned over the surface of the track. The race line helps you position your car through a corner.

Shifting
Provides for automatic or driver-controlled gear shifting. *Auto* shifting will automatically shift the gears up or down depending on the current speed and gas pedal position.

Braking
Provides for automatic or manual braking. *Auto* braking will slow your car to the proper cornering speed for a turn and maintain the car at or below that speed throughout the corner.

Steer Help
Allows steering help to be enabled or disabled. Steer help will "help" the car follow an ideal line through a corner. This should be turned on for first-time XCar Pro users.

Increasing The Frame Rate Of Game Play

Normal video plays back at 30 frames every second. The lower the frame rate, the jerkier the display seems. At low enough frame rates, even quick maneuvers will seem sluggish. Even though the X^{n}gine® technology used in XCar Pro is inherently faster than typical 3D systems, the processing power of your computer may not be fast enough to produce acceptable frame rates. When XCar Pro is first started, it will automatically test the speed of your machine and adjust options to increase the frame rate. XCar was designed so that you can increase the frame rate by sacrificing graphic realism. The following is a quick list of options that can improve your frame rate.

Horizon
Turn off the textured horizon to improve frame rate. The textured horizon will be replaced by a solid blue horizon. Turn the horizon off using the *Graphics* options screen under *Horizon*.

Resolution
Use low resolution. To use low resolution, select 320x200 from the *Resolution* section of the *Graphics* options screen.
Note: Resolution can not be changed for the 3Dfx version of the game.

Number of Opponents
Racing against fewer cars will increase frame rate. To reduce the number of opponents, reduce the value on the *Opponents* slider under the *Realism* menu.

Textures
Turn textures off. The least noticeable textures are the walls and grass. When textures are turned off they are replaced with a comparable solid color. To turn textures off, toggle the corresponding option on the *Graphics* options screen.

Trees and Buildings
Lower the number of trees and buildings rendered. Do this by selecting *Trees* or *Buildings* from the *Graphics* options and reducing the level.

Render Distance
Shorten the render distance. The render distance can be adjusted from the *Graphics* options screen.

Race Line
Disable the race line option. Turn *Off* the *Race Line* from the *Realism* options menu.

XCAR

THE CARS

XCar Pro simulates the next generation of closed-wheeled, closed-cockpit race cars. These cars, often referred to as sports-prototypes, have a rich history. They are typically manufactured to showcase new technology and design techniques. Few are ever sold to the public. Instead, they are manufactured in limited quantities and raced in various classes.

Each car featured in XCar Pro has a unique sponsor, design and default setup. Even though each car is different, their default setups make them essentially equal. The default setup is adequate to begin racing, but to be really competitive you will have to modify your car to suit a particular track as well as your own preferences.

To select a car, choose **Select Car** from the **Main Menu**. Using the up/down cursor keys, mouse, or joystick, select a car from the list of cars. This list will continuously loop through all the available cars. Once you have chosen a car enter a new name for the driver. This name will be saved along with any changes made to the car in the **Modify Car** section of the program.

Modifying The Cars

In order to be competitive on different tracks you must modify or "fine tune" your car. In XCar, you can select from lists of components, modifying everything from engines to wings. There is usually a specific optimum setup for each track, and XCar will allow you to save as many setups as you wish. Each setup is "chassis independent," meaning that you can select a different car and load any setup into the new chassis. However, a setup may not be ideal because of the different aerodynamic properties, wheelbases, and component locations in each chassis (affects weight distribution). To modify your car, select **Modify Car** from the **Main Menu**.
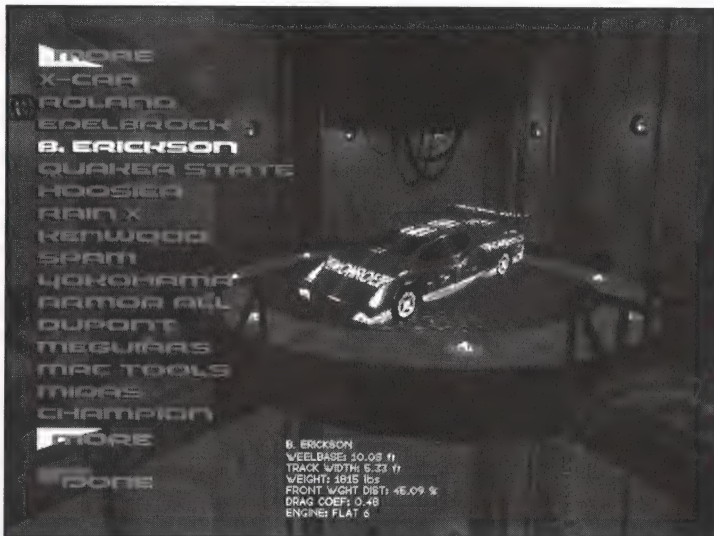
The keys used to select and modify options on the **Modify Car** screen are shown in **Table–4**.

Ideally, your car should have neutral steering (see **Driver's School** on page 38),

Modifying The Cars

and be properly powered and geared for the specific track on which your racing.
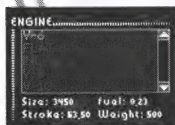
Engine
You can select from a variety of engines. Each has advantages and trade-offs. An engine that produces more power will typically weigh more, and have higher fuel consumption and wear factors.

Smaller, lighter engines won't produce as much power but can be more fuel efficient. Experimentation is the only way to know what works best on a particular track. The graph area will display its dyno-based torque and horsepower curve.

You can also modify power curves and import engine files from Motion-PC or DeskTop Dyno simulations. See page 42 for additional information on these exclusive Pro-Pack features.

Gears
Gearing is very important to getting around the track in the quickest time. Gears should be selected so that the maximum amount of acceleration is achieved when exiting corners. The best way to determine the best gear is to view the telemetry data for each corner and record your corner speeds. Select a gear that will put maximum engine torque at this speed. Do this for each corner and figure out your best gear set. Remember that you must still be able to switch between gears without bogging down the engine. Select gears based on their ratios.

Table 4—Modify Car Controls

Option	Key Command
Move to Next Item	Cursor Down key
Move to Previous Item	Cursor Up key
Move to Next Section	TAB key
Toggle an Item	ENTER key
Increase an Item	+ key
Decrease an Item	– key
Leave Modify Car	ESC key
Reset an Item	R key
Help on Item	F1 key
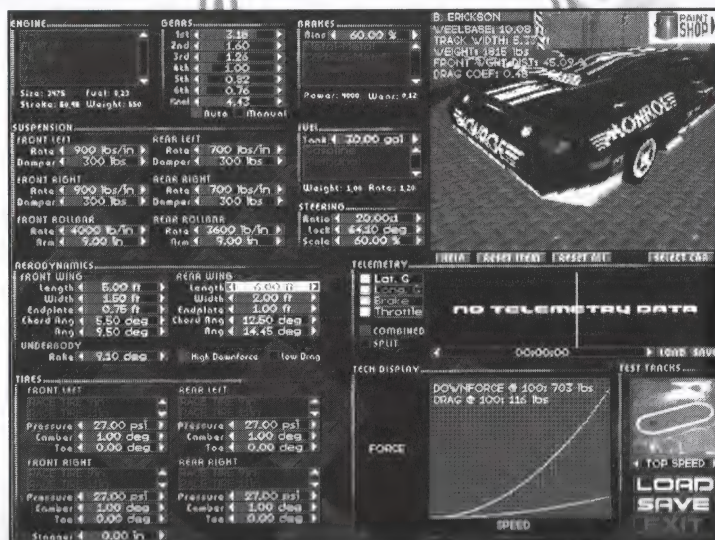
Modifying The Cars

This means that if a gear has a ratio of say 3.14:1, this indicates that input speed will be 3.14 times faster than the output speed. The **Final Drive** gear is the ratio of the differential and it affects all other gear ratios. First gear should only be used for the start and when exiting the pits. The other gears should be spaced to get the best performance. Top gear (6th) gear is usually used as a gas mileage gear for long straights and is only slightly different from 5th gear. Reverse gear is not changeable by the user, but it is within the range of a first gear. The graph area shows the disbursement of the gears and what speed matches maximum engine torque.

The **Auto** and **Manual** buttons determine whether shifting will be done automatically or manually by the player (this is equivalent to the **Shifting** option under **Realism** discussed on page 17).

Brakes
The brakes on the XCars are all of the "disc" type. Different brakes have different stopping capabilities, fade characteristics and wear rates. Select the type of brake that best suits the track. For example, if you're racing on a high speed oval where brakes are rarely used, choose a compound that has good stopping power but high wear rates. On a twisty road course where brakes are used constantly, select a set with long life that are resistant to fading. **Brake Bias** is used to set the amount of force going to the front and rear brakes. Typically, more force is directed to the front brakes because of the effects of weight transfer during braking (weight shifts onto the front tires). If you experience loose behavior (the back end seems to spin out) while braking, it usually indicates that more bias is needed at the front. If the car pushes while under braking (front end won't turn), it usually means that there is too much front bias.

Suspension
The suspension is the most adjustable part of the race car. The suspension components link the car to the tires. The springs control the wheel travel rate and affect the weight transfer while cornering. The **Dampers**, or shock absorbers, are velocity-sensitive and affect weight transfer and wheel travel depending on the rate of a turn or bump. The damper also keeps the tire on the road by absorbing the recoil effect of the spring. You can individually adjust the spring and damper for each wheel. The front and rear **Roll Bars** only affect the weight transferred while cornering. The stiffer the roll bar, the more weight is transferred. The roll arm also affects the "stiffness" of the bar but is controlled from the cockpit. The suspension should be set up to your liking and should make the car neutral steering.
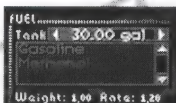
Fuel
You can select tank capacity and several types of fuel for use in your engine. Each has different properties, with trade-offs in weight and efficiency. The **Tank** size is useful for planning your pit strategy. The tank size should be adjusted so that the minimum amount of fuel is used to fill the tank at each stop. The less fuel carried, the lighter the car, and the faster it can accelerate. Select a fuel that matches your track objective and pit strategy.

Steering
The steering of the car can be adjusted in three ways. The first is the **Steer Ratio**. The steer ratio indicates how the turning of the steering wheel affects the turning of the tires. The lower the steering ratio the faster the tires will turn. In XCar Pro, the farther the

joystick is moved, the farther the tires will turn. The second is *Steer Lock*. This is the total range that the tires can turn. The greater the range, the tighter the circle that the car can turn. The third adjustment is a *Speed Scale*. This allows you to adjust steering response as speed changes. As speed increases, so do the effects of steering input. Some controllers are very sensitive to this and this setting will help compensate for the sensitivity.

Aerodynamics

Wings are the key to great lap times. Because a car is made to be light for fast acceleration and braking, the amount of force on the tires is reduced. This makes the car more slippery in turns. The best way to overcome this effect is by applying additional weight through the use of wings. The front and rear can be individually adjusted to compensate for a car pushing (understeering) or being loose (oversteering). However, there is a trade-off in drag (lowers top speed) when a large amount of wing is used. The wings should be adjusted to accommodate a particular track. On a high speed oval, minimal wing should be used so that top speed is the highest possible. On a twisty track, use more wing so that cornering speeds are highest. The length and width of a wing affects the down force/drag in minor ways, as does the endplate size. The wing chord angle is the fixed angle of the wing and can't be adjusted outside of the *Car Modify* screen. This should be set to some minimal or middle value. The *Wing Angle* is the adjustable angle of the wing. This angle can be changed during pit stops. Use this angle to correct steering problems during a race. The *High Downforce* and *Low Drag* buttons allow the selection of the wing configuration. A High Downforce wing has multiple stacked wings that generate a larger amount of force and drag. The Low Drag configuration has a single wing to minimize drag.
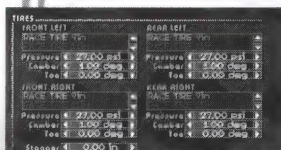
Tires

Several factors affect the way your tires perform. Few factors are widely understood, fewer still are user-changeable. The user-controllable parameters are; *Vertical Load* (see suspension), *Compound* or Tire Type, **Camber**, *Pressure*, and *Toe*. Since Caster largely affects driver feedback, it has been fixed and is not changeable. You can select from several sets of tires. Each has unique properties and is suitable for different cars, tracks and environments. Individual tires can be selected for each wheel. In addition, you can set individual Inflation Pressure, Camber and Toe. Each of these settings will affect tire rolling drag, tire temperature, and tire grip. Tire pressure is often used to make minor adjustments to compensate for tire temperature or to add small amounts of understeer or oversteer. Its affect on rolling drag and grip are minor. Camber has dramatic effects on cornering force and should be set to achieve the highest forces possible (typically falls in the 1 degree range). Camber has only minor affect on rolling drag and tire temperature. Toe affects the steer characteristics of the car and is typically set near zero. The graph area displays the tire's cornering force curves at various loads along with the tire's current temperature and percentage of wear. As you can see from the graph, the force a tire can exert will rise quickly and reach a peak. This peak is the maximum force a tire can exert and is the point where the tire begins to slide. Maximum performance is achieved by keeping the tires working at the maximum point on the curve. The surface temperature of a tire should be as uniform as possible. An over-inflated tire will have a higher temperature in the center. A cooler temperature in the center indicates under-inflation.

Modifying The Cars

XCar Pro includes a unique **Tire Editor** that allows you to modify, and even design, tires for your race car. See page 45 for more information on using the Tire Editor.

Telemetry

Telemetry data is very useful for setting up your car. It provides a means to measure the effects of set up changes—an otherwise hit or miss proposition. The telemetry window can display a variety of information. Telemetry is recorded whenever you start a race, practice, or use a test track. The telemetry window displays various data in graphic form. You can select the interval displayed by adjusting the slider below the window. Up to four streams of data can be displayed at once. The data displayed is selected in the boxes to the left of the telemetry window. **Combined** means the data is displayed on the same graph. If the graph is **Split**, it shows the first two and then the second two selections separately.

Telemetry data can be loaded and saved and can be viewed in the VCR (see page 31 for more information on using the VCR feature). Weight transfer data (in the form of a G-G diagram) accompanies the selectable telemetry data. The data shows the weight being applied to each tire and the forces and directions being applied to the center of gravity of the vehicle (refer to the G-G Diagram in the **Physics of Auto Racing** on page 40 for more information on reading G-G Diagrams). Telemetry data is stored in RAM while driving. On a minimum configured set up, there is enough memory to typically store about four minutes worth of data. Pressing the 0 (zero) key during a race will reset the telemetry buffer and restart recording (erasing the data previously in the buffer). The following telemetry data is available for display:

Lateral G-force (Lat. G)
The lateral (or sideways) G-force on the center of mass in the vehicle. A negative value indicates a force to the left.

Longitudinal G-force (Long. G)
The longitudinal G-force usually caused by braking or applying throttle. A negative value indicates deceleration.

Brake pedal position (Brake)
The amount of brake power being applied. Data is displayed as a percent of maximum.

Gas pedal position (Throttle)
The amount of throttle being applied. Data is displayed as a percent of maximum throttle.

Steering input (Steer)
The amount of steering input being used. The data is displayed as a percentage of full lock. Negative values indicate the wheel is turned to the left.

Current gear (Gear)
Indicates the current gear.

Current speed (Speed)
Indicates the current velocity of the car in MPH or KPH.

Current engine (RPM)
Indicates engine RPM.

Left-front suspension (LF Trav.)
A measure of the current left-front suspension travel measured in inches.

Right-front suspension (RF Trav.)
A measure of the current right-front suspension travel measured in inches.

Left-rear suspension (LR Trav.)
A measure of the current left-rear suspension travel measured in inches.

Modifying The Cars

Right-rear suspension (RR Trav.)
A measure of the current right-rear suspension travel measured in inches.

Left-front slip (LF Slip.)
Indicates how much the left-front tire is sliding. A value of 1 indicates the tire is fully sliding.

Right-front slip (RF Slip.)
Indicates how much the right-front tire is sliding. A value of 1 indicates the tire is fully sliding.

Left-rear slip (LR Slip.)
Indicates that the left-rear tire is sliding. A value of 1 indicates the tire is fully sliding.

Right-rear slip (RR Slip.)
Indicates that the right-rear tire is sliding. A value of 1 indicates the tire is fully sliding.

No display (None)
Do not display any data.

Split times
A Split time is a measure of the time it takes to complete a segment of track rather than a whole lap. Segments are measured from the center of a corner to the center of the next corner. On the telemetry display, split times are represented by a white, vertical line or bar. The number below the bar indicates the corner in which the split was recorded. The top number to the right is the current split time. The number below is the difference in split times between the current pass and the previous pass.
Note: Two laps must be completed before the split time difference can be displayed. Split times are useful in tracking improvements or locating problems in individual sections of the track.

By analyzing the telemetry data it is possible to determine what forces were acting on the car, what the driver was doing at a particular time, and how the car responded. For example, if the telemetry data indicated

that the rear wheels broke loose while cornering and less weight was transferred between the rear wheels, then loosening the rear by using less spring or less roll bar will probably fix the problem. The telemetry data can also help improve your driving skill by observing the overall forces, braking points, and acceleration points. The closer the overall force on the car is to the traction limit (as indicated in the G-G diagram) the higher the lap speeds will be. By watching this data you will know which corners you are taking incorrectly and what you need to do to solve the problem.

Test Tracks

There are four test tracks on which to test your car:

The Top Speed Oval
This track is used for testing aerodynamic effects, engines, and handling characteristics at high speeds.

The Skid Pad
The skid pad is used for testing steady state cornering and tire grip.

G-G Diagram Of Wheel Forces

LF WEIGHT
RF WEIGHT
BRAKE
TRACTION LIMIT
RIGHT TURN
LEFT TURN
FORCE VECTOR
ACCELERATE
LR WEIGHT
RR WEIGHT
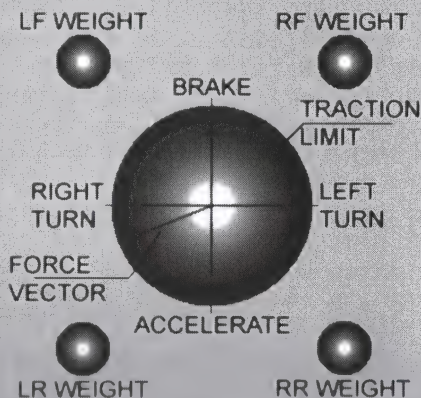
Modifying The Cars/Setup Tips

The Braking Track
Used to test both 1/4 mile speed and braking distance.

The Handling Track
This track is best used for testing transient handling properties.

Select a track by adjusting the slider below the icon. Click on the track icon to enter the test track.

Loading and Saving Setups

Individual setups can be saved and loaded by selecting *Load* or *Save*. You may want a different set up for each track and each car. The same set up can be loaded "into" different cars but the adjustments may not be optimal because of differences in shape, size and component positions on the cars.

Resetting Data

While tweaking your car you may find that you want to start over with the normal, default set up. Setup items can be reset back to their default value by selecting the *Reset ALL* button.

Getting Help

On-line help is available on most items on the *Car Modify* screen. To get help, select an item and click the *Help* button. Selecting an item with the right mouse button also will display a help screen without changing which item is currently selected.

MODIFYING AND SETUP TIPS

The following information provides a quick reference to the effects of modifying various car components.

Springs and Dampers

Adjust springs/dampers to affect grip in corners and suspension travel.

Stiffen front springs
> Adds understeer.
> Car is more stable.
> Less front grip on bumpy surfaces.
> Greater traction on corner exit.
> Greater front tire wear.
> Less "dive" under braking.

Stiffen rear springs
> More oversteer.
> Car is less stable.
> Less rear grip over bumps.
> Less traction on corner exit.
> Greater rear tire wear.
> Less "squat" under acceleration.

Stiffen front dampers
> More understeer in bumpy turns.
> Increased steer responsiveness.
> Less front grip on bumpy surfaces.
> More front tire wear.

Stiffen rear dampers
> More oversteer in bumpy turns.
> Increased steer responsiveness.
> Less rear grip over bumps.
> More front tire wear.

Anti-roll Bars

Adjust roll bars to affect grip in corners.

Stiffen front
> Adds understeer.
> Less front grip on bumpy surfaces.
> Greater front tire wear.

Stiffen rear
> More oversteer.
> Less rear grip over bumps.
> Less traction on corner exit.
> Greater rear tire wear.

Wings

Adjust wings to affect grip and top speed.

Increase front
> Increased oversteer.
> Increased aerodynamic drag.

Increased cornering speeds.
Reduced top speed.
Can affect rear wing effectiveness.

Increase rear

Increased oversteer.
Increased aerodynamic drag.
Increased cornering speeds.
Reduced top speed.

Gear Ratios

Adjust gear ratios for maximum acceleration out of corners and down straights.

Increase (lower number)

Increased top speed.
Less acceleration.

Decrease (larger number)

Lower top speed.
Greater acceleration.

Brake Balance

Adjust brake bias to optimize braking performance.

Increase front bias

Understeer under braking.
Front tires can lock.
Braking distance can increase.

Decrease front bias

Oversteer under braking.
Rear tires can lock.
Braking distance can increase.

Steering

Adjust steering parameters to fit the track.

Decrease steer ratio

Wheels turn faster.
Allows tighter turns.
Improves racing on twisty tracks.
Less stable.

Increase steer lock

Wheels turn further.
Allows sharper, tighter turns.
Can be less stable at high speed.

Increase steer scale

Less influence with higher speed.
Increase number for high speeds.

THE TRACKS

Grattan Raceway Park

Location:	Belding, Michigan
Length:	2.00 Miles
Major Event:	SCCA Nationals
Track Record:	Raul Boesel, Jaguar GTP 1:05:00
Difficulty:	Hard
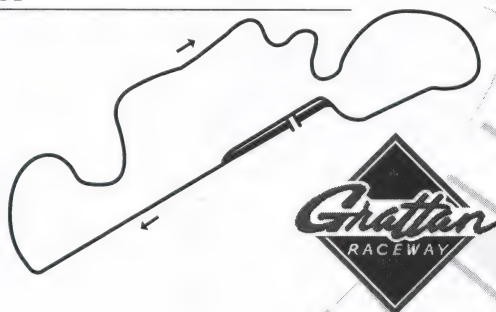
Infinity Loop

Location:	Mobius, Italy
Length:	1.2 Miles
Major Event:	Mobius 200
Track Record:	C.Tracy, Hoosier IV 20:82, 207.49 mph
Difficulty:	Easy
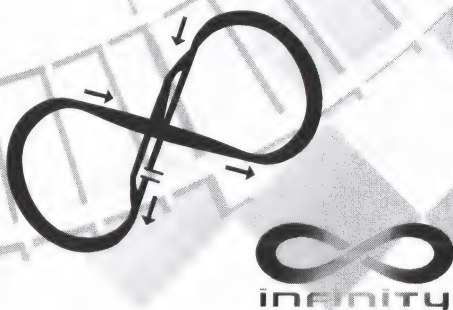
Lime Rock Park

Location:	Lakeville, Connecticut
Length:	1.53 Miles
Major Event:	IMSA World Sports Cars, IMSA
Track Record:	P.J. Jones, Toyota-Eagle MKIII 43:11.2, 128.595 mph
Difficulty:	Easy
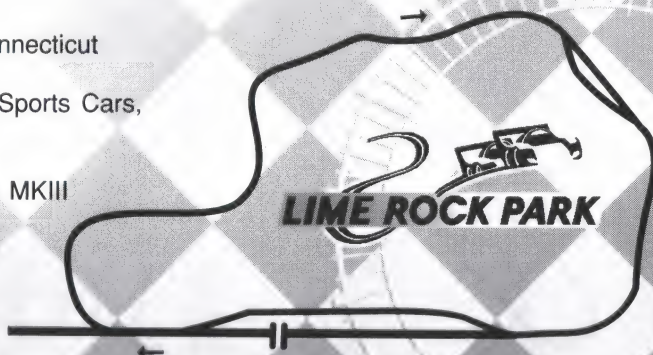
The Tracks

Mayan Concourse

Location: Cicitta, Brazil
Length: 4.0 Miles
Major Event: Emerald Basin 200
Track Record: B.Rydlach,
MAC Tools GT
1:41:92,
141.29 mph
Difficulty: Hard

MAYAN CONCOURSE
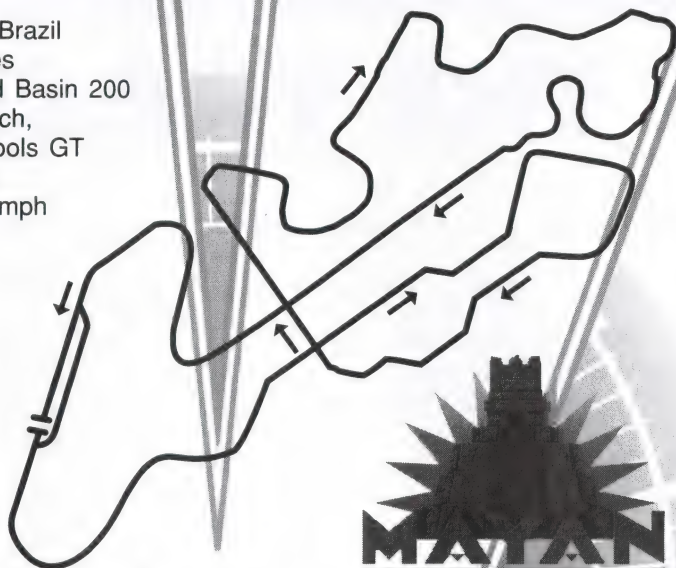
Mid-Ohio Sports Car Course

Location: Lexington, Ohio.
Length: 2.25 Miles
Major Event: Miller Genuine Draft 200,
INDYCAR
Track Record: Paul Tracy,
PENSKE PC22-Chevy
1:08.564,
118.138 mph
Difficulty: Medium

MID-OHIO
SPORTS CAR COURSE
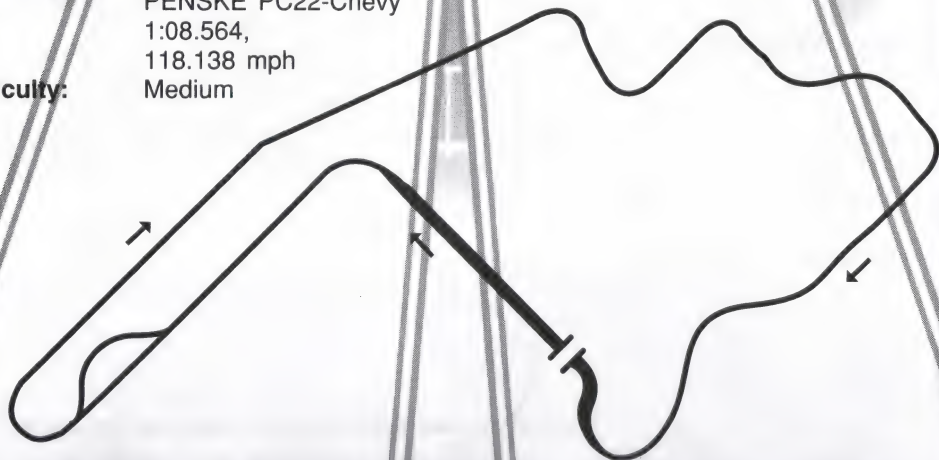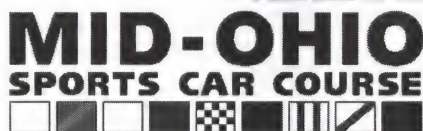
The Tracks

Putnam Park

Location: Brownsburg, Indiana
Length: 1.8 Miles
Major Event: National Endurance Race, WERA
Track Record: Scott Goodyear, Indycar 54:54, 118.81 mph
Difficulty: Medium

PUTNAM PARK
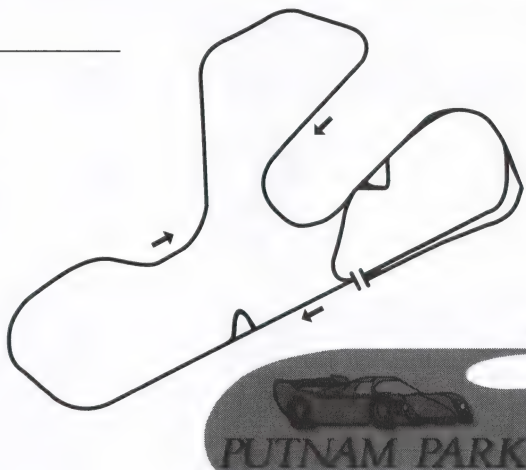
Red Rock Speedway

Location: Mesa Grande, Arizona
Length: 1.5 Miles
Major Event: Red Rock 200
Track Record: C.S. Weavin, Meguiars MR-1 26:55, 203.39 mph
Difficulty: Easy

RED ROCK
SPEEDWAY

Seattle Grand Prix

Location: Seattle, Washington
Length: 5.7 Miles
Major Event: Seattle Grand Prix
Track Record: B.Darrelson, SW-20 Quaker State 2:23:91, 142.59 mph
Difficulty: Hard

SEATTLE
GRAND PRIX
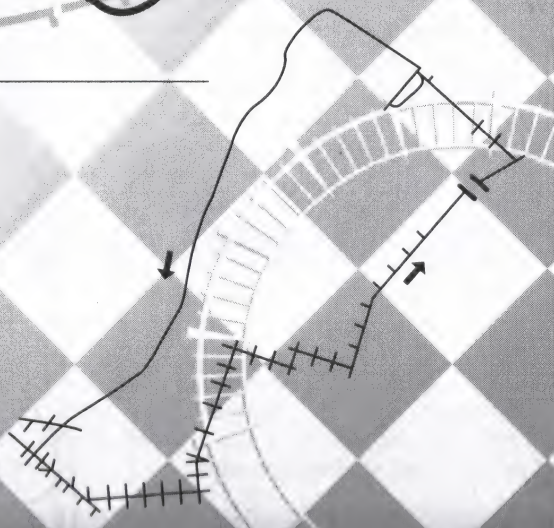
The Tracks

Thunderhill Park

Location: Willows, California
Length: 1.9 Miles
Major Event: Harvest Festival, SCCA
Track Record: Chuck Billington,
C-Sports Racer
1:10:00,
97.714 mph
Difficulty: Medium
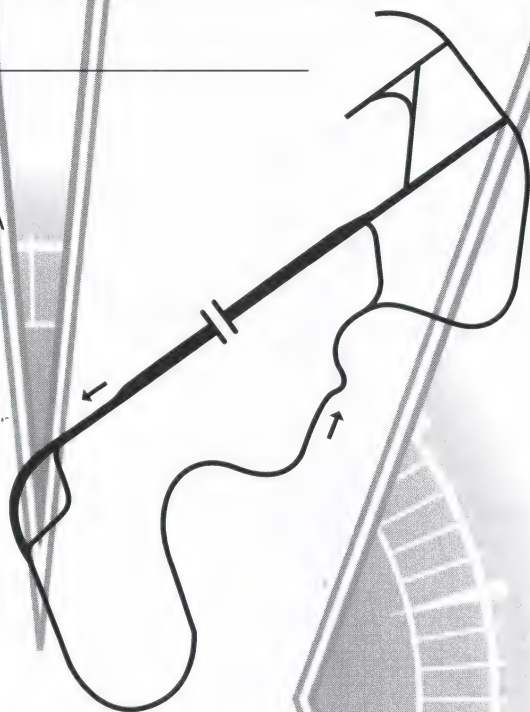
Timberland Pass

Location: Oak Village, California
Length: 3.3 Miles
Major Event: Trailhead 200
Track Record: K.Reigns,
DX-5 Champion
1:13:31, 162.05 mph
Difficulty: Medium

CXR PROFESSIONAL

THE VCR

During a race, practice, or test session, telemetry data from your vehicle is recorded. The VCR function is used to display this information. Data can be played back from multiple views and at various rates. Using the VCR, it is possible to view telemetry data synchronized with the visual data of the race. This can be an invaluable resource for improving your car setup and your driving skills.

The VCR is accessed from the *Main Menu* screen by selecting *VCR*. Data must first be recorded or loaded before it is available for viewing.

The VCR contains three control panels. The panel on the right side of the screen controls camera selection, loading/saving of videos, the total length of the video, and the current position of the playback. The small slider in the center enables positioning the playback anywhere in the data by moving the slider to the desired time. There are five different views to choose from. *Chase Car* view will position the camera behind and above your car. The *Helicopter* view will position the camera directly above your car at a high altitude. The *In-Car Front* view will position the camera on the hood in front of the driver. The *In-Car Rear* view will position the camera behind the driver, looking backward. The *Track-*
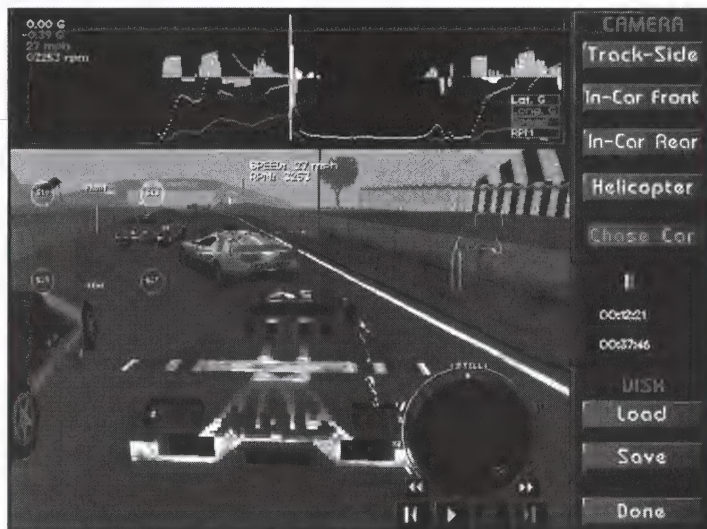
Side camera will place a static camera at various points on the track which will follow your car as you pass (like TV coverage). The *Save* button will allow you to save the current data. You can choose to overwrite an existing name or to save under a *New* name. The *Load* button will select a previously saved file for viewing.

The "floating" control knob contains the controls for viewing the data. The control knobs mimic the Jog and Shuttle controls found on VCRs and VTRs. The center ring can be used to advance the video a single frame.

The << and >> buttons will reverse or advance the playback at a variable rate. The rate depends on how far the shuttle control is moved, as

The VCR Recording/Playback System

indicated by the small white dot on the outer ring. The closer the indicator is to the **<<** or **>>** symbols, the faster the playback speed.

To rewind the data to the beginning, press the **I<** button. To advance it to the very end, press the **>I** button.

To view the playback at normal speed, press the **>** button.

To stop the video, press either the **STOP** (square) button or rotate the round (Jog) control knob to the **STILL** position.

The panel at the top of the screen, along with the overlaid graphics below, are the telemetry data displays. The top portion displays user-selectable telemetry data in graphic form. The boxes overlaid on the graph area indicate what data is displayed and what color the data is being displayed with. To choose a different data type, simply select a box. A menu of the available types will be displayed. Select the data type you would like and the graph area will be updated with the new information. The overlaid graphic to the left displays the current weight distribution of the vehicle and the G-force vector acting on the center of gravity. If the G-force vector draws outside the center circle, it indicates that the car has exceeded its maximum traction limit and is sliding. This data allows you to analyze how weight is transferred and at what point the car exceeds its friction limit. The map simply displays where on the track you and your opponents are.

The functionality of the VCR is optimized for mouse input, however, keyboard commands are also available and are listed in **Table-5**.

Table 5—VCR Controls

Function	Command
Play	P key
Stop/Pause	SPACE key
Rewind to start	HOME key
Forward to end	END key
Shuttle faster	CURSOR LEFT key
Shuttle slower	CURSOR RIGHT key
Chase view	C key
Hood view	F key
Rear view	R key
Helicopter view	H key
Trackside view	T key
Modify telemetry 1	F5 key
Modify telemetry 2	F6 key
Modify telemetry 3	F7 key
Modify telemetry 4	F8 key
Load	L key
Save	S key
Done	D key
Rotate View Left	< key
Rotate View Right	> key

RACING

XCar supports four types of racing. **Pre-season** consists of a solitary session on any of the tracks. **Multi-player** racing allows racing against human opponents (multi-player will be covered in the **Multi-Player Game** section on page 36). **Single Race** (also **Quick Race**) allows racing on a single track against computer-controlled opponents. **Circuit Racing** begins a "season" of racing on a series of tracks and includes point tracking for overall standings.

Preseason

Preseason racing is accessed from the **Main Menu** screen by choosing **Preseason**. You will then be asked to select a track. The Preseason select screen will now be displayed. From here you can select **Practice**, **Modify Car**, or return to **Main Menu**. Choosing Practice will position you in the pits on the selected track. You can run as many laps as you wish. To return to the Preseason menu, press the **ESC** (escape) key. Choosing **Modify Car** will take you to the adjustments screen to your modify the current setup. Pressing **ESC** from the Preseason menu will return to the **Track Select** menu, allowing the selection of another track.

Single Track

Choose **Single Track** from the **Race** menu. You must then select a track. The weather conditions will be determined based on the track location and typical weather conditions (providing **Weather** has been turned on under the **Options Menu**,

see page 16). You can now participate in two **Practice** sessions, **Modify** your car, **Qualify**, or **Race**. The Practice sessions allow you to run on the track under the current conditions and make adjustments to your car. **Modify Car** allows you to change the current setup of your car.

Qualifying

When racing a **Single Track** or a **Circuit** race, you should qualify to determine your starting position. The better you qualify, the closer to the head of the field you will be placed. If you choose to skip qualifying, you will start at the back of the pack. A qualifying session consists of the fastest of four laps. These four laps can be completed at any time but are usually run consecutively. The first lap of a qualifying session is considered a warm-up lap and is not counted. After qualifying, you are no longer allowed to modify your car.

Circuit Select

XCar Pro features 10 tracks. **Circuit Select**, however, allows you to select any or all of these tracks to race in sequence. Tracks are chosen by selecting the those you want to race from the **Circuit Select** screen. The tracks will be raced in the order they are selected. To remove a track, simply select it again. It will be removed from the list. Once the tracks have been selected, the racing will begin in sequence. After a race is finished, points will be awarded for the top 12 places. The point values are shown in **Table-6**. After all the races have been run for the season, an

Racing, The Basics

overall winner will be determined based on the combined scores for all the races.

Loading A Saved Game

A previously saved game can be loaded from the Race screen. Select *Load Game* then select a game from the list. Games can only be saved during a pitstop (see **Pitstops**, below).

During The Race

The Pit Board

The pit board (shown on the next page) is displayed at the end of each lap. It indicates the current lap, your position, your current lap time, the time interval to the car ahead of you, the interval to the car behind you, and the laps left in the race.
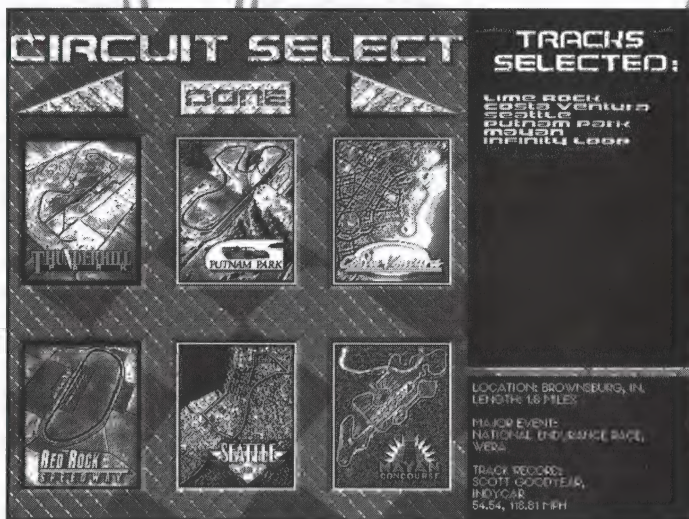
Start Flag
A green start flag is used to signal the start of the race or to resume racing after a caution flag.

Finish Flag
A black-and-white checkered flag is used to signal the finish of the race.

Black Flag
Indicates that a driver must stop in his pit on the next lap. A black flag can be the result of speeding in the pit lane or passing under yellow.

Black Flag with Orange Circle
Indicates that a driver is

CIRCUIT SELECT

TRACKS SELECTED:
Lime Rock
Costa Ventura
Seattle
Putnam Park
Mayan
Infinity Loop

LOCATION: BROWNSBURG, IN.
LENGTH: 1.8 MILES

MAJOR EVENT:
NATIONAL ENDURANCE RACE,
WERA

TRACK RECORD:
SCOTT GOODYEAR,
INDYCAR
54.54, 118.81 MPH

Table–6 Awarded Points

Finish	Points Awarded
1st place	20 points
2nd place	16 points
3rd place	14 points
4th place	12 points
5th place	10 points
6th place	8 points
7th place	6 points
8th place	5 points
9th place	4 points
10th place	3 points
11th place	2 points
12th place	1 point

Racing, The Basics

The Pit Board

Current Lap →
Current Lap Time →
Time/Laps To Next Car →

LAP: 2   POS: 5
01:28:07   +01:54
+01:39   1 LAPS
10 LAPS LEFT

← Current Position
← Prev. Lap Difference
← Time/Laps To Prev. Car
← Laps Remaining

having mechanical problems that might endanger him/herself or other drivers.

Yellow Flag

Signals a situation that may be dangerous. Drivers should slow down and be prepared to stop. Drivers are not allowed to overtake or pass until the green flag is shown.

White Flag

Signals that the race has one more lap to go.

Light Blue Flag

Signals a driver that he/she is being overtaken by a faster car.

Honoring A Black Flag

If a player receives the black flag he/she must pit within five laps or be disqualified. To clear the black flag, simply stop at your pit and then continue on. No pit work can be done under a black flag.

Pitstops

Use pitstops to make minor changes to your car during a race or practice. Enter-

ing your pit can be tricky, but with practice it becomes easy. To enter your pit, slow to less than 70 mph and move into the pit lane. Look for your pit crew and lollipop (the **X** sign on a long pole). Pull into the pit slot between your pit crew and the pit wall and stop before you pass the lollipop.

Once in the pit, you will automatically be raised up on jacks and ready for pit work to begin. While in the pit the game is paused while you make decisions. During a pitstop, you can make adjustments to your wings, tires, and brake bias. To change a tire, highlight the box next to the pressure indicator. Once everything is set, select **Done** and the work will be performed. The game is not paused during the "work" phase of your pitstop, and there will be a time penalty for each job being done. While in the pits, you can choose to **Save** the game in progress. The game will be saved in its current state and it will restart with you in the pits.

Note: During a multi-player race, pitstops are handled automatically to avoid pauses in the game. Once in the pits, your car will be repaired and refueled and the tires will be changed as needed.

Racing in the Rain

Other than bright, sunny weather, rain is the only condition under which a race will take place. In normal situations, driving on city streets in the rain isn't much more dangerous than on dry roads, since

traffic speeds are much lower. Racing in the rain, however, is much more challenging. Your driving techniques must be precise and there is little margin for error.

A major consideration with wet weather racing is visibility. Depending on the density of the rain, forward visibility can be reduced to less than a hundred yards. And track conditions are much more slippery in the rain. Slick tires are definitely out of the question, and rain tires will only provide about 60% of the dry-track equivalent. This means that speed must be much lower, and therefore, weight transfer will also be reduced. Shocks and roll bars should be loosened, brake bias should be adjusted, a softer brake compound should be used. Wings should be adjusted to provide maximum downforce (since drag is less important under these circumstances).

The driver should carefully apply the brakes and gas. Since the track is slippery the car is much more likely to skid. Planning ahead is important, and knowing exactly when to apply the brake and gas is critical.

Note: XCar Pro automatically selects rain tires when rainy conditions exist.

Multi-Player Game

Multi-player gaming allows you to play against human and/or computer players via modem or an IPX-compatible network. Multi-player game play is accessed by selecting **Race** from the **Main Menu**, then choosing **Multi-Player** from the **Race Screen**. Remember that, as stated in the Software License Agreement, each player must own a unique, licensed copy of XCar—installing the same copy of XCar on more than one machine is a violation of copyright and is illegal!

Starting Modem Play

Modem play allows two human players to race against each other via a serial con-

nection. Regular modems and Null modems (direct connect) are supported.

The first step is physically connecting the machines. For null-modem connections, connect to one of the serial ports. Most computers come with two serial ports labeled COM1 and COM2. Either port works fine. Now launch XCar on both computers. Select modem play by selecting **Modem** from the **Multi-Player** menu.

For play via a modem, modem type and other parameters must be specified. For direct-connect play, select **Direct** under **Type**. XCar is compatible with many common modems. Select your modem from the list. If your modem is not listed, select **Generic 14.4 Modem**. To set-up the modem, select **Modem Setup** from the **Modem** screen. **Modem Setup** will allow the selection of the following:

COM port
This is the communication port you with to use.

IRQ (interrupt request line)
This is the IRQ selected to accommodate the COM port.

Init
This is the initialization string that will be sent to the modem.

Reset
This is the reset string for the modem (usually ATZ).

Hangup
This is the hangup string (usually ATH0).

Done
Returns to Modem Screen.

The strings are modem-specific and can be found in the documentation accompanying your modem. In order for XCar to communicate smoothly, it requires that the data be passed through the modem immediately—not compressed, buffered or error

corrected. A typical command string would start with an AT followed by a string of characters. You need to determine and supply the commands to:

1. Reset the modem.

2. Set compression to off or none.

3. Turn error correction off.

If you need to insert control characters, use the ^ character (i.e., **^M** stands for **Control-M**). There is no need to insert a carriage return at the end of the string. Next, select a baud rate. The baud rate is the rate at which XCar sends data. Since XCar can only send data as fast as the baud rate, the higher the baud rate the faster the frame rate. The down side to higher rates is that they are more prone to errors from unshielded cables or phone-line errors. XCar Pro supports 14400, 19200, 28800, 38400, 57600, and 115200.

If multi-play will be accomplished via a null-modem cable between two computers, you must specify **Direct** (null modem) under **Type** from the **Modem** screen. Finally, you need to select either **Call** or **Answer**. Who is dialing and who is answering should have been established before hand. If you select **Call**, you will be prompted to type the phone number to dial. If you are to answer, select **Answer** and wait for the call.

Once a connection has been established, XCar will locate the fastest machine and that machine will become the "master." The master system is granted the ability to select the track, race length, and other parameters. These parameters are then passed on to all other machines. Play resumes as a normal race.

Starting Network Play

Network play uses the IPX network protocol to communicate between players. Up to eight players can connect. Network play is accessed by selecting **Network** from the **Multi-player** screen.

When Network is selected, XCar will attempt to find a game that is currently being set up by another user. If it can't locate another user initiating play, you will be prompted to start a new game and the following information will be requested:

Mode
You can select **Action** or **Realistic** mode.

Damage
This option is active only if you select the **Realistic** mode. You can select **Realistic**, **Minimize**, or **None**.

Computer Cars
This is the number of computer-controlled cars that will race with human players.

Skill Level
This is the skill level of computer opponents. This option does not affect the human cars.

Laps
This is the number of laps in the upcoming race.

Done
Finishes setup.

Once the options are set, XCar will wait for players to log onto the game. As each player logs on, the car image and player name will be displayed. During the logging-in period, players may leave and re-enter the game at any time, but once the race has started, no more players may join a race. Once the desired number of players are present, the host of the game (i.e., the player who first selected the Multi-Player options) may start the race by pressing the **ENTER** key.

Note: Changes made to a car in the Paint Shop will not be visible to other players in the multi-player game.

Pausing the Game

While racing, the game can be paused by pressing the **F5** key. During a pause you can turn on or off several options including: Horizon, Spin Help, Race Line, Steer Help, Shift Help, and Brake Help (for more information on these options see the *Realism* section on page 17). A filled box indicates that the option is currently on.

In addition, you can save the last 15 seconds of telemetry data by selecting *Quick 15* and then typing a name. The file will be saved as a normal telemetry file and can be loaded and viewed in the **VCR** or **Car Modify** screens.

Note: This option is not available in modem or network play.

DRIVER'S EDUCATION

Here are a few tips from the experts that will help you excel in both XCar Pro and the real world of road racing.

Mental Skills

As is true for most sports, the best competitors are the most mentally fit and prepared. In order to be a great driver, it is important that you study and know your controls, your car, and the track. In racing, things happen fast—too fast for your brain to contemplate the situation and reason out the best move. Your entire body must be programmed to act appropriately in a situation without "thinking." This takes a lot of effort and study. The mentally prepared driver will be able to sense what his car is doing and react in an instant.

Surviving the Start

XCar uses a standing start, similar to Formula 1. This means that the cars will begin from a standstill on the main straight, lined up in a staggered fashion.

The start is easily the most dangerous and exciting part of the race. Don't get nervous. The best approach is to go easy on the throttle and hold your line through the first corner. Let the traffic thin out a bit before you make any moves to pass. If you lose a position or two, don't worry. There will be many opportunities throughout the race to make up lost positions. If you are lucky enough to qualify on the inside, hold your line through the first corner and don't worry about moving up in traffic. If you start on the outside, hold your line and look for the first opportunity to get onto the race line.

A lot of first lap accidents happen because of cold tires. Don't push too hard during the first few turns. Let your tires come up to operating temperature. After the first lap, your tires should have warmed up to an ideal temperature.

The Race Line

The best path around a corner is one that allows the maximum amount of lateral acceleration and the least amount of steering lock. Every track has at least one racing line. Some call it the racing "groove." It will be difficult to win unless you attempt to stay in the line. On most tracks, the racing line shows up as a subtle (sometimes not so subtle) dark path caused by rubber scrubbing off the tires or oil and other liquids being laid-down on the track. Watch for this "groove" and try to follow it through the turns. When approaching a corner, locate where the groove drifts and shift your car in the same direction. As you enter a turn, notice if the groove moves toward the apex of the corner (see the next section for more information on the "apex" concept). As you exit, stay in the groove as it will help you set up for the next turn.

Another way to learn and follow the ideal race line is to follow one of the computer controlled cars through the race. They will always do their best to stay on the ideal race line. You may also turn on an artificial representation of the race line by turning

on *Race Line* in the *Realism* options or by pressing the **F10** key during the race. Following the race line is almost always the fastest way around the track. By paying attention to this line you will learn when to brake, turn, and get back on the throttle.

Cornering

Cornering involves two driver judgments: **speed** and **path** through a corner. Proper cornering requires a lot of practice and a good study of the course. The most popular way to describe optimum cornering is with the "apex" concept. Your goal here is to take a corner in the straightest possible line. Often this means entering the corner as close as possible to the wall, cutting across the track to the "apex" of the turn, and exiting the corner as close to the outer wall as possible. The point where you reach the apex is determined by the radius of corner and the condition of the track that follows. If there is a straight section after the corner, it is a best to hit a late apex in order to gain as much acceleration down the straight. If the current turn precedes another corner, take the apex in a manner that will offer the best setup for the next turn.

The fastest drivers are always aware of which corners must be taken slowly and which corners may be run with heavy throttle. Overdriving slow corners causes tire scrub and generates excessive wear and slow exit speeds. On the other hand, the experienced driver will concentrate on carrying as much speed as possible through fast corners.

Braking

Braking is a key to winning races. The later you can brake in a corner, the faster your lap times will be. As you practice, make a mental note where you have to start braking in order to successfully enter and exit a corner. Most tracks have braking markers or cones to help you judge

distances and locations. If there are no markers, look for natural landmarks.

Brakes produce maximum force just before the tire locks up. A locked tire produces less braking force, so, it's essential to set the brake bias correctly to help your car stop without the front or back tires locking up.

The basic rule to braking is to apply braking force while the vehicle is still in a straight line before entering a corner. In practice, drivers try to brake hard in a straight line then let up slightly when entering a corner, finally releasing the brake when they reach full cornering force. This may sound simple, but takes much practice to master.

Overtaking and Passing

Except in rare situations, overtaking and passing is done during braking and cornering. A pass is typically set up by "outbraking" another car and moving to the inside to force the lead car out. It is important to remember that the car being overtaken has right of way unless the passing car has sufficiently asserted itself. In other words, if the passing car has overtaken the leading car by more than half a car length, the car being overtaken must yield and follow a longer line through the corner. Once a pass has occurred, it is important to position your car in front of the car being passed. Otherwise, they will pass you back, since they have taken a line that enables them to accelerate before you.

The Pits

Valuable time can be gained or lost in the pits. A successful pit strategy is important. Pitstops should be arranged so that you need only carry the amount of fuel on board that will allow for the fewest stops. Modern racing tires will out last the fuel load on most race cars. Fresh tires will help, however, as worn tires offer less traction. Tire changes should be planned to

The Physics Of Auto Racing

complement optimal fuel use. Adjustments to wings can be made with little time penalty. Use wing adjustments to correct oversteer or understeer problems. Avoid suspension changes whenever possible.

THE PHYSICS OF AUTO RACING

It is important to have a basic understanding of the physical forces acting on your vehicle. Vehicle dynamics is the study of these forces. Dynamics can be broken down into understandable parts so that you can apply this knowledge to properly setup the car.

Forces

Every object has mass. According to Newton's second law, a force must be applied to any mass in order to accelerate it or change its directions. The actual forces involved are very complex, but the forces that the driver can control (steering, acceleration, and braking) are aimed at a very small area of the vehicle: The Tire Contact Patch. This is, as they say, where the rubber meets the road; the interface between the tire and the road surface. The forces applied by the tire are limited by the amount of friction that can be generated between the surface of the tire and the road. If the exerted forces are greater than the friction limit, the tires slip or skid. The consequences can be disastrous.

Centripetal Forces

Centripetal forces are created when a vehicle is turning. Picture an object being swung at the end of a string, fast enough so that the string stays taut. The same forces causing the string to stay straight are acting outward on a turning vehicle. The amount of force depends on the radius of the turn and the speed of the vehicle. Centripetal force is sometimes referred to as lateral G-force.

Engine

The engine is used to generate torque on the driving wheels and produce forward, or longitudinal, motion. If the engine produces more force than the tires can handle, the tires will spin. It is important to note that a lot of the power produced by the engine never reaches the tires (as much as 30%). This lost power is consumed, in part, by the need to acceleration engine, gearbox, and drivetrain components. This is one reason racing designers try to use components with the lowest mass and moments of inertia, while still maintaining sufficient strength.

Brakes

Brakes produce the reverse longitudinal force used to slow or stop the car. Brakes are aided by other forces, more or less out of the control of the driver, such as tire rolling resistance and aerodynamic drag.

Suspension

The suspension is in constant motion. As forces are applied, weight is transferred to different tires. The suspension parts are responsible for handling and controlling these shifts in weight. Most of the tasks associated with setting up a car have to do with optimizing suspension components.

Tires

The tire is the most important and least understood element of race-car dynamics. All of the interaction between the car and the road flows through the tires. If the forces at the wheels cause the tires to exceed their traction limits, the vehicle begins sliding and friction is reduced. Before the tire reaches its maximum friction limit, it will produce various "slip" angles, usually less than 12 degrees. The slip angle is the angle between the direction the tire is pointing and the actual direction the tire is moving.

The Physics Of Auto Racing

Slip angle progression throughout a turn is often very linear, with the peak occurring as the vehicle exits the turn. The force and slip angle produced by the tire is principally controlled by the vertical load on the tire and, to a lessor degree, by the tire camber and pressure.

The G–G diagram

A common method of visually representing all the forces acting on a race car is a G-G diagram. It displays forces as a directional line and the maximum force that the tires can withstand as a circle around the zero point or center. If the force line extends outside the circle, the force is too great for the tires and the vehicle begins to skid.

A typical G-G diagram will display the load for each tire in addition to total vehicle forces. The directional line represents a vector (or directional) sum of the forces acting on the tires. For example, if a vehicle is braking and turning left, the line would point to the right and backward.

The combined force between braking and centripetal force is represented by the length of the line. When a vehicle has reached optimum performance, the force line should remain near the edge of the friction circle. Maintaining these forces requires a fine balance between acceleration, braking, and turning. The best drivers control these forces so that the tires are always just under their traction limit.

G-G Diagram Of Wheel Forces

LF WEIGHT RF WEIGHT BRAKE TRACTION LIMIT RIGHT TURN LEFT TURN FORCE VECTOR ACCELERATE LR WEIGHT RR WEIGHT
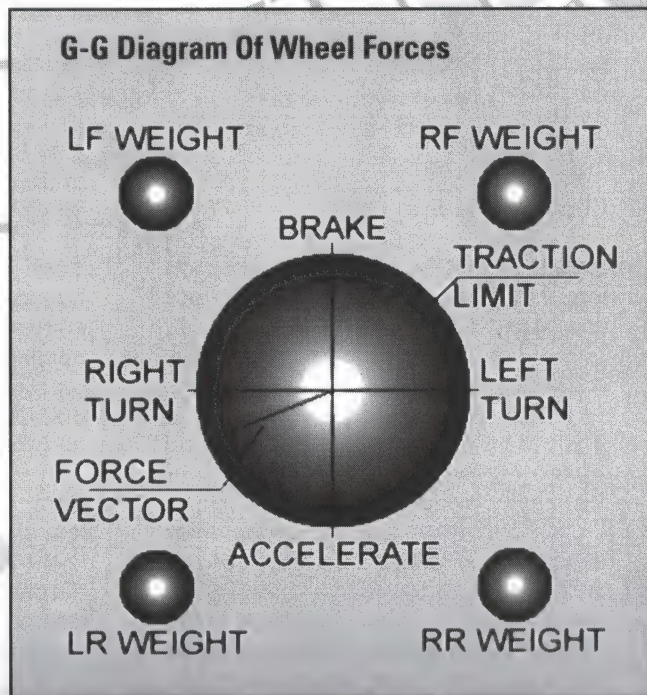
USING PRO FEATURES

The XCar Pro Engine Editor

XCar Pro includes six different engines, ranging from a flat 6 to a V12, that you can install in any vehicle. The Engine Editor program, developed especially for XCar Pro, allows you to import torque curves from Motion Software's engine simulation programs. The XCar Pro Engine Editor is compatible with Mr. Gasket's DeskTop Dyno and Motion Software's Dyno Shop (versions 2.5 to 2.8).

Using The Engine Editor

The XCar Pro Engine Editor (ENGED.EXE) is located in the ENGEDIT folder. The ENGEDIT folder was installed in the XCAR directory on your hard drive.

1) To start the engine editor, double-click on **ENGED.EXE**.

2) Choose **FILE**, then **OPEN**.

3) Under **Files Of Type** displayed at the bottom of the file-dialog box, open the drop-down box and select **Dyno Files (*.DYN)**. This will display all of the dyno-test files in the selected directory.

4) If you wish to load dyno files that you have designed, change the path to your Dyno software folder (e.g., DYNO25, or DYNO28) on your system. On the other hand, if you wish to simply import one of the sample files provided with XCar Pro, select one of the Dyno files visible in the window. When loaded, the torque curve will be displayed in the Engine Editor window.

5) To transfer this engine torque curve into XCar Pro, choose **SAVE AS** from the **FILE** menu. The Engine Editor asks for a Torque File name; enter **ENGINE06** (it's the next engine in sequence and we'll use it for this example; enter ENGINE followed by a zero, six), then click OK. Next, the Engine Editor will ask for a path and file name for the engine description file. For this example, enter the same **ENGINE06** name and select a path into the **XCAR/TECH** directory (this is where the original six engine description and torque files that are supplied with XCar Pro are located, numbered 00 through 05).

6) In order to "register" this new engine with XCar Pro, you must restart XCar. After restarting, you will find the imported engine located at the bottom of the list of engines displayed the top-left of the **MODIFY CAR** screen.

7) **TIP1:** Add engines to XCar Pro in sequence: Start with ENGINE06 (the seventh engine) and continue to add engines naming them ENGINE07, ENGINE08, etc. This unbroken sequence will insure that all engines will be properly registered and displayed.

8) **TIP2:** Since only the first eight characters of the engine description are visible in the XCar Pro engine list, pick a short but descriptive name for the engine (copied from the "Engine Description" entered in the Dyno simulation) while you are building the engine in the Dyno. While not

required, you can change or modify the engine description in the Engine Editor by selecting **MISC**, **ENGINE NAME** before you save the file as an ENGINE file for XCar.

The XCar Pro Paint Shop

The Paint Shop can be used to customize the appearance of any car (this option is not available in the 3Dfx hardware-accelerated version of XCar Pro). The Paint Shop screen requires a mouse for proper operation. Displayed below the Paint Shop title is the current texture set for the car. The window to the left shows a 3D representation of the car. The right window is the drawing window. This is where you can manipulate the appearance of the vehicles. The color bars in the center of the screen show the color palette used by XCar Pro. You can assign any of these colors to the left and right mouse buttons. To select a color from the palette, click (left or right) in the palette area. You can also use the Pick tool from the tool bar and select any color from within the drawing window.

The paint shop comes equipped with the following tools:

Brush tools
The top row of buttons activate various brush sizes ranging from 1 pixel to 8 pixels.

Line tool
Draws a line. Press and hold the mouse button, then drag and release.

Box tool
Draws a filled box. Press and hold the mouse button, then drag and

release.

Fill tool
Fills an area with color.

Swap tool
Swaps all occurrences of selected color with another.

Cut tool
Copies an area from a texture to a temporary, "holding" area. Press and hold left mouse button, then drag the mouse. The paste tool will automatically be selected.

Paste tool
Allows pasting or decal or from the "holding" area. When pasting an image, the color assigned to the right button will be considered transparent.

Pick tool
Selects a color from an existing texture.

Undo tool
There is one level of undo. Selecting this tool will restore the texture to its state before the last drawing change.

Using XCar Pro Features

Zoom tools
The button with the - sign will zoom the drawing windows out. The button with the + sign zooms in on the current texture.

Image position tool
The four arrows shift the image around within the drawing window so that the entire texture may be modified.

Decal tool
Allows pasting of predefined decals. Select a decal from the box and stamp it in the Drawing Window.

Flip tool
Flips the copy area or a decal horizontally or vertically, or both.

Rotate tool
Rotates the copy area or a decal by 90°, 180°, or 270°.

Import button
Imports a texture from a GIF-format file (see Importing Textures).

Export button
Will export a GIF-format file of the current texture set.

Reset button
Will reset the texture set to the one supplied with the original version of XCar.
Note: The Reset function will not work on cars that were not included with the original XCar CD.

Load button
Allows you to select a car to paint.

Save button
Saves any changes made to the car.
Note: Selecting Save will overwrite the current texture. If you want to restore the default texture set, press **R** and choose **Yes** at the prompt. The original texture set will be restored from the XCar Pro CD (see above note).

Exit button
Quits the Paint Shop and returns to XCar Pro.

Using The Paint Shop

Select a texture to edit from the top section of the screen by clicking the left mouse button on a texture. The texture will appear in the drawing window, centered around the point you selected. As you draw in the Drawing Window, the changes will be reflected in the texture area and on the 3D model. The 3D model can be rotated, shifted and scaled by selecting the arrows overlaid within the 3D area.

Importing Textures

The Export and Import features allows textures to be edited in an external paint program. Selecting Export will save a copy of the current texture set to a GIF-format file saved. The file is placed in the SAVE directory within the directory in which XCar was installed. Using an external paint program, you may modify this file in any manner **except** that the following rules must be followed:

1) Do not change the palette. The cars, tracks, backgrounds, and dashboards must all use the same palette. If you use Photoshop®, copy the palette of the original image to a file before you begin modifications. The reapply the palette to the modified image before you save it (this insures that the image is composed of the original, XCar palette).

2) Do not change the size of the tex-

tures. Only the same size textures can be re-imported.

3) Don't change the size of the screen. Make sure the screen is a 640x480, 256 color image when it is saved from your paint program.

4) Make sure the modified screen is saved into the SAVE directory and has a **GIF** extension. XCar will only find files stored in this directory.

Once you have edited and saved the texture set, you must import each texture, **one at a time**. Follow these steps:

1) Select the texture you want to import by left clicking on the texture in the texture area of the Paint Shop.

2) Select *Import* from the button bar along the bottom of the screen. A box will appear showing all the GIF screens contained in the SAVE directory. Double click on the one you want to load.

3) You should now see a screen with your textures in a white box the size and shape of the texture you selected earlier. Move this box over the screen region that contains the graphic you with to replace and press the left button (pressing the right button will exit).

4) The Paint Shop will now display your new texture in place. You will need to repeat this process for each texture you wish to import. Remember to *SAVE* your changes before you exit the Paint Shop if you want the modifications to appear in the game.

The XCar Pro Tire Editor

Produced from "secret data" from a top tire manufacturers, the XCar Pro Tire Editor lets you adjust 17 unique tire coefficients. By adjusting the up-and-down arrows next to each data point, you can design the ultimate tire for your application. The data that makes up each of these coefficients is so secret that only the effects of each coefficient can be revealed. Tire

manufacturers have forbidden us from divulging what the actual coefficients refer to; for example, hardness, temperature, sidewall stiffness, etc. Perhaps you can figure out what each one actually is?

The XCar Pro Tire Editor also lets you adjust the camber, pressure, and tread width. Save your creations and import them into the game!

Customization: Each curve on the graph represents different vertical loads. The load is shown directly below the graph (only the 200 lbs. load is not shown). The curves represent what force the tire generates at different angles.

Y axis = Force generated by the tire.
X axis = Slip Angle. The angle that the tire is traveling relative to straight ahead.

Do not set the slip angle too far to the right since it indicates that your tires have soft side walls, reducing cornering performance.

The Peak Of The Curves: The peak of each curve is the maximum force that the tire can produce. When racing around a corner, if you go over that peak, the tire will slide. If you are under the peak, you are not using the tire to its maximum potential.

Ideally, you want the curve on the graph to have a high peak. However, if the peak is very sharp and drops off quickly, handling will be erratic.

Tire Science: To understand what impact tires have in racing, here's some information you may find useful.

Everything the driver feels and every action the driver takes to control the car acts through the tires. Basically, it can be stated this way: The better the grip, the better the car will react to all G-force loads. But aerodynamics and tires are co-dependent: Aerodynamics are often use to increase downforce, and downforce improves tires traction.

A vehicle turning a corner is actually

accelerating towards the center of an arc that describes its path. The cornering forces that tires generate are called lateral forces or side forces. In any turn, regardless of how slight, a tire will always "slip" outside the optimum turning arc. This slip angle is the angle between where the tire is pointed and where the car is actually going. Tire tread deforms as it rotates through the contact-patch area and then recovers as weight is removed. This deformation is essential in producing the lateral force needed to change the path of the vehicle.

Temperature: Just about everything on a tire is affected by the temperature. Tire temperature greatly changes the durability of tires. If tires get hot, the rubber begins to melt and the tires loose grip with the surface. Localized heating can wear tires remarkably fast. Uniform weight distribution will minimize heat buildup.

In addition, warming tires to the optimum operating temperature will greatly increase traction. Even in XCar Pro, cold tires at the beginning of a race will offer considerably less than optimum traction. However, as the race continues, tire temperature increases and so does traction. If tire temperature gets too high, usually after a couple of really hot laps, you'll start to notice a reduction in handling capabilities. Expert racers will use this to their advantage in devising strategies to outmaneuver their opponents.

Width: The width of the tire directly affects handling. Generally speaking, the wider the tires, the greater contact with the road, and the better the grip. However, wider tires have increased rolling resistance and aerodynamic drag that can slow the car down.
TIP: *Using a wider set of tires on the rear of a car has advantages. Rear tires offer less aerodynamic drag. Rear tires (generally) are used to transmit more forces (in rear-drive vehicles) so larger tires provide better acceleration and handling during heavy throttle periods.*

Inflation Pressure: Tire pressure is often used to modify tire temperature or to add small amounts of understeer or oversteer to vehicle handling.

Tires also act as "suspension" spring/dampers, and tire pressure affects the "spring rate" of the tire. While the affect of tire pressure on rolling resistance and grip are relatively minor, keep this in mind: Small changes in inflation pressure usually make a big difference in the spring rate of the tire and in overall handling.
TIP: *If a tire has excessive air pressure, it is less compliant to bumps. This will degrade handling characteristics and increase the likelihood of the driver losing control.*

Camber: The camber is the measure of the tilt of a tire when viewed from the front. In racing situations, camber is used to adjust the position of the tire so that the maximum tread is in contact with the ground during hard cornering. Camber also has dramatic affect on rolling resistance and tire temperature.

Race cars are usually setup with relatively large negative camber, since this improves tire contact with the ground and that improves the ability of the tires to sustain larger lateral forces.

Unfortunately, large camber values can dramatically increase tire temperature. If the tire runs on the inside corner in the straightaways, local heating can degrade tire performance. For courses with only a few hard corners, a camber setting of zero is usually best.

Toe-In And Toe-Out: Toe affects the steering characteristics of the vehicle. Most road race vehicles have the toe adjusted to nearly zero degrees. Increasing the toe slightly may improve steering accuracy and may also help maintain ideal tire temperatures.

Stagger: Stagger is the vertical size difference between the left- and right-side tires.

Making one side larger forces the car to turn. This technique is primarily used on oval tracks where the vehicle is always turning the same direction.

Rain Vs. Dry Compounds: Rain tire compounds are optimized for wet grip and require wet surfaces maintain optimum temperatures. Rain tires deteriorate quickly at higher temperatures. Dry tires are nearly useless in the rain since they allow a thin layer of water (a good lubricant) to build up between the road and the tire (the hydroplane phenomenon). For the most part, rain tires use similar tread patterns except that they often incorporate large grooves to direct water flow away from the tire contact patch.

Some race teams prefer to groove their own tires or modify a rain tire with their own "specialized" pattern. Regardless, wet roads are always more dangerous even with rain tires, so overall speed and cornering is much more challenging.

NOTE: Optimum Rain or Dry tire compounds and tread patterns are automatically selected by XCar Pro to match current track conditions.

Using The XCar Pro Tire Editor

The XCar Pro Tire Editor (TIREED.EXE) is located in the TIREEDIT folder. The TIREEDIT folder was installed in the XCAR directory on your hard drive.

1) To start the Tire Editor, double-click on **TIREED.EXE**.

2) Notice the seventeen coefficients along the right side of the screen. Each of these variables adjust specific tire parameters. You can modify each by clicking (and/or holding) on the up and down buttons next to each variable. The values will change within a fixed range. At the top of the screen are 10/1, 1/1, and 1/10 buttons. Selecting 10/1 will make large changes; 1/1 smaller changes, and 1/10 will make very small changes for each button click.

3) Choose **FILES**, then **OPEN**.

4) Path to the XCAR/TECH directory to locate the two tire files (TIRE00.TIR and TIRE01.TIR) that are supplied with XCar Pro. **Note:** The tire files are loaded on your hard disk only when the larger versions of XCar Pro are selected during program installation.

5) Load in one of the existing tires. Try modifying the parameters to maximize the holding forces. Give the tire a new name in the name box at the top of the screen. Then choose **FILES**, **SAVE AS**. Enter the next sequential tire file name (in this case TIRE02.TIR). Finally, select **SAVE**.

6) This will save the modified tire. In order to "register" this new tire with XCar Pro, you must restart XCar. After restarting, you will find the imported tires located in the tire selection lists displayed near the bottom of the **MODIFY CAR** screen.

7) **TIP1:** Add tires to XCar Pro in sequence: Start with TIRE02 (the third tire) and continue to add tires naming them TIRE03, TIRE04, etc. This unbroken sequence will insure that all tires will be properly registered and displayed.

Mr. Gasket Demo Video

You will also find a GSKTDEMO folder on the XCar Pro CD-ROM (this folder will not be transferred to your hard drive during XCar installation). The Readme.txt file inside this folder will explain how to start the demo video on your PC.

When the demo video opening screen is displayed, you may click on any product "box" to view an exciting video describing each product.

If the video does not play when you click

on a product "box," you need to install QuickTime on your system. Simply open the Quickt12 folder and run either QtWin31 (for Windows 3.1x users) or QtWin95 (for Windows95 systems). Just follow the on-screen instructions. After installation, the Demo Video should play.

If you have any problems running this demo video, please contact:

Motion Software, Inc.
535 West Lambert, Bldg. E
Brea, CA 92821-3911
Voice: 714-255-2931
Fax: 714-255-7956
Web: www.motionsoftware.com
Email: support@motionsoftware.com

Keep watching the Motion Software web site (www.motionsoftware.com) for additional updates, new tools, and utilities for

FAQs & SOLUTIONS

Solving Startup
And In-Game Problems

XCar Pro has been tested on many systems and combinations of video-graphics cards, operating systems, and software configurations. It will operate properly on a wide variety hardware/software platforms (refer to the list of compatible hardware found in the Read.me file on the XCar Pro CD-ROM). However, it is possible that you may encounter installation or operational problems, since virtually every PC is unique in some way. Our testing has indicated that XCar Pro problems can be solved in over 90% of the cases by reviewing and applying the information in this manual, especially in the following FAQs. Please take a few minutes and look over the solutions presented here before you contact technical support (Motion Software only provides technical support to registered users; mail in your registration card today):

Problem: My mouse does not work in the XCar Pro installation program and within XCar Pro itself.
Solution: Mouse drivers must be loaded during DOS bootup to enable mouse op-

eration within XCar Pro. Refer to the instructions that were supplied with your mouse and review the illustration and caption below for more information on DOS mouse drivers. If all else fails, we recommend that you purchase a Microsoft™ mouse. They are easy to install for both DOS and Windows operation.

Problem: The SETUP program won't recognize my sound card and there is no sound when I press TEST.
Solution: The AUTO-DETECT during installation can sometimes improperly determine the sound card in your system, resulting in no sound or even system lockup. Verify that the sound card you are selecting is the one installed in your system. If all else fails, select the basic "Sound Blaster" choice from both the Digital and MIDI menus. If this still does not produce sound, find out the exact sound card in your system, the port values to which it is linked, and the interrupt numbers assigned to the sound card (refer to the hardware manual that accompanied your computer for help). Then rerun the SETUP program and enter the correct values.

Here is a typical AUTOEXEC.BAT file that loads hardware drivers and executes configuration commands during DOS startup. The line "C:\MOUSE\MOUSE.COM" loads a mouse driver for DOS operation. A command similar to this is required to use the mouse during installation and operation of XCar Pro.

```
SET SOUND=C:\PROGRAM\CREATIVE\CTSND
SET MIDI=SYNTH:1 MAP:E MODE:0
SET BLASTER=A220 I10 D0 H5 E620 T6
PROMPT $p$g
C:\MOUSE\MOUSE.COM   <-- Mouse Driver Loads Here
PATH C:\WINDOWS;C:\WINDOWS\COMMAND
C:\WINDOWS\COMMAND\DOSKEY /BUFSIZE=2048
SET TEMP=d:\temp
```

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Problem: I can't hear any digital sound.
Solution: First try rerunning the sound-board setup program. Select the sound card you have installed (or let setup auto-detect it). Be sure to try the **TEST** sound function. If you get a test sound, XCar should have sound. If this doesn't fix the problem, make sure the volumes of the sound effects are turned up. Do this in the **Sound Options** from the **Options** screen.

Problem: XCar Pro locks up just after I start it or when I enter the CONTROL SELECT screen.
Solution: Your sound card is set incorrectly or is defective. Check your system settings and re-configure your sound card (run SETUP in the XCar directory). Try selecting NO SOUND during sound configuration, if XCar Pro runs, the problem is definitely sound-board configuration.

Problem: The music is too loud and I can't find a volume control in XCar.
Solution: XCar plays audio directly from the CD-ROM and can not control the output volume. If the music is too loud, adjust the volume in your mixer program supplied with your sound card or CD drive manufacturer (or just turn down the volume control on your speakers, if so equipped).

Problem: Program displays an error message indicating a video problem when I start XCar Pro.
Solution: A non-compatible video driver or the lack of a VESA driver on your system usually causes these error messages. Your display must be capable of displaying 640 x 480 x 256 colors. Try installing the VESA driver in the UNIVBE folder found on the XCar Pro CD-ROM (run INSTALL in that folder). This will often solve the problem.

Problem: XCar Pro will not recognize my joystick.
Solution: XCar Pro will only detect joysticks that are connected to the standard joystick port. If a joystick requires a special game card or has multiple connectors that attach to your computer in more than one place, XCar Pro may not recognize your joystick. Some computers have multiple joystick ports; i.e., one on the sound car and one on a multi-I/O card. Only one of the ports will function at a time and the other port must be disabled. Make sure your joystick is plugged into the active port. Look in the hardware manual that accompanied your computer for additional help.

Problem: I installed a different joystick and I cannot properly calibrate it.
Solution: Every joystick generates its own unique range of motion values. The calibration setting in XCar Pro (a calibration separate from the one you may have performed in the Joystick control panel within Windows) must be reset whenever joystick changes are made. To do this, select **OPTIONS** from the main selection screen in XCar Pro. Then choose **CALIBRATE JOYSTICK**. Press R to reset the joystick values, then move the joystick throughout its full range of motion in every direction. Finally, press one of the joystick buttons (or press Enter) to "lock-in" the newly calibrated values.
Note: If the previous joystick calibration is causing the menu selections to cycle from one to the next so fast that it is impossible to make a selection, exit XCar Pro, and delete the **Joystick.cal** file in the SAVE directory. This will reset all joystick calibrations.

Problem: After I play the game awhile, it begins to slow down and the screen "gets stuck."
Solution: If you are running XCar Pro under Windows95, make sure you have XCar properties (right-click on the XCar icon on your desktop) set to: Don't allow screen savers; Background always suspend; Sensitivity Low. And make sure that any Energy Saving features of Windows are disabled. If the problem persists, run XCar Pro from DOS.

Problem: I installed the 3Dfx version of

Frequently Asked Questions & Answers

XCar Pro and my system crashes with a memory allocation error or will not run the game.

Solution: First of all, make sure your system is equipped with a compatible 3Dfx video acceleration card (e.g., Diamond Monster 3D). If you are running XCar Pro with 16MB of Ram, you may not have sufficient available memory. Try disabling any TSR (terminate and stay resident) programs, such as virus protection, screen savers, or any other applications that may be running in the background. Also if the game runs for awhile then bombs, try reducing the number of textures and cars in the **OPTIONS**, **GRAPHICS** setup screen. If you are still experiencing problems, obtain the latest versions of video drivers for both your standard video card and your 3Dfx card (most card manufacturer's post the latest drivers on their websites).

Problem: The 3Dfx graphics don't look as good as they should.

Solution: The 3Dfx textures are half size (by default) to speed game play on some systems. If you want the highest quality, go to **OPTIONS** and then **GRAPHICS** and turn the texture settings to **FULL**.

Problem: I tried to install the minimum size XCar Pro software-rendered version on top of the previously installed 3Dfx version and it won't run.

Solution: The 3Dfx version is basically a large install so when you install a minimum install on top of it, XCar gets confused. Delete the XCar directory installed on your hard drive, then reinstall the program.

Additional 3Dfx Notes: If your machine has less than 24MB of RAM and a 3Dfx video-graphics accelerator, this information may be helpful:

The 3Dfx driver supports Windows 95, Windows NT 4.0, and MS-DOS. There is no current native support for OS/2. There is an unsupported Linux Glide library. If you are running within DOS (**not** a DOS Prompt or DOS Shell under Windows) and you have less than 24MB of RAM you must set the environment variable DOS4GVM to 1 in the autoexec.bat file. For example: **SET DOS4GVM=1**

If you are running under Windows 95 and you have less than 24MB RAM you may have to change your DOS properties settings (right-click on the XCar icon). The value for DPMI memory must be changed from AUTO to 16384. The initial environment setting must also be changed from AUTO to a minimum of 4096 for some applications. Glide programs built for DOS4GW cannot be run under Windows NT.

Problem: The cars are difficult to control and/or the steering is very sensitive.

Solution: The cars are much easier to control with a steering-wheel and pedal set instead of using a joystick or mouse. See the Motion Software website for steering wheel options. Joystick vary widely; some are quite linear and easy to "drive," others are super sensitive. To get the best performance from a joystick, first, re-calibrate (see above). You can also adjust the steering sensitivity under the MODIFY CAR screen. Decreasing the STEER LOCK, and increasing the STEER RATIO and the STEER SCALE will all reduce steering sensitivity. If all that fails, try resetting the car to its default configuration by selecting RESET ALL from the MODIFY CAR screen.

Problem: I am using a game pad to control XCar Pro. I am having problems controlling the cars; driving control seems erratic.

Solution: If you are experiencing problems when using a game pad or other non-proportional input device, specify a **-A** or **-B** in the command line when starting XCar (**XCAR –A**). XCar will treat your joystick differently and allow smoother steering control.

Problem: After crashing, I can't get the

car turned around and back into the race. **Solution**: First make sure you have SPIN HELP turned on in the OPTIONS REAL-ISM screen. To turn the car back towards the track, make sure it is completely stopped, then release all controls and it will slowly "creep" toward the correct direction.

Problem: I am having problems with slow response playing in the network mode. Cars act jerky, etc.
Solution: If you experience poor frame rates in the network mode, the person who initiated the game should press the F12 key. This will attempt to re-synch all the machines and often solves slow-response problems.

Problem: The main selection screen seems slow and takes a few seconds to respond to my mouse or keyboard.
Solution: This is caused by a slow computer that spends most of its time updating the graphics display rather than processing input commands. Pressing the DEL key will turn off the 3D display and improve performance during main menu selection (but only during main menu selection). Pressing DEL again will re-enable the 3D display.

Problem: When I try to import textures in the Paint Shop, the imported screen doesn't look right and the colors have changed.
Solution: The texture must be in GIF format and be saved as a 640 x 480 x 256 color image, using the same color palette as that used in the game.

Problem: Were are textures exported from the Paint Shop placed?
Solution: When a texture set is exported it is placed into the SAVE directory, within the XCAR directory.

Problem: Can I modify the dash of any vehicle?
Solution: You can modify the look of the dash boards by editing the GIF files in the

CARS directory. There are three separate files, one for each screen resolution. Be careful not to modify the "window" area of the display.

Problem: Why don't modified textures show up on other machines during network play?
Solution: The modified textures are only saved on the machine on which the changes were performed. If you copy the modified textures to other systems on the network, the modifications will be viewable on that system, too. Here is a list of texture files associated with each car (they are located in the TEXTURES directory):

0	XCar	TEXTURE.225
1	Roland	TEXTURE.213
2	Edelbrock	TEXTURE.210
3	Monroe	TEXTURE.212
4	Quaker State	TEXTURE.211
5	Hoosier	TEXTURE.214
6	Rain X	TEXTURE.215
7	Matco Tools	TEXTURE.216
8	Spam	TEXTURE.219
9	Yokohama	TEXTURE.222
10	Armor All	TEXTURE.217
11	Dupont	TEXTURE.231
12	Meguiar's	TEXTURE.223
13	Mac Tools	TEXTURE.230
14	Mr. Gasket	TEXTURE.221
15	Champion	TEXTURE.224
16	Motor Trend	TEXTURE.078

For example, if you modified the Mr. Gasket car, you would copy the texture file TEXTURE.221 to the other computers on the network in order make those changes visible to everyone.

Problem: I painted my car in the Paint Shop in the "Software" version of XCar Pro, but I don't see it the same changes if I run the 3Dfx version.
Solution: The two versions use different texture systems so cars modified in the software-rendered version or the stand-alone paint shop don't show up in the 3Dfx version of XCar Pro.

Glossary

Active Suspension—Term used to describe a software-controlled suspension that automatically adjusts suspension components to accommodate specific situations.

Aerodynamics—The interaction of a gas as it flows over and around the surface of a moving object. On race cars, an inverted wing is used to force a car onto the ground to improve traction.

Anti-roll Bar—Part of the suspension assembly that acts to prevent the car from rolling when cornering. The bar is designed to transfer force from the loaded tire to the unloaded tire, thus reducing the tendency of the car to roll.

Apex—In racing, **apex** describes the point in a turn at which the car is closest to the inside of a corner on an ideal racing line.

Balance—The amount of oversteer or understeer a car demonstrates while cornering.

Brake Bias—The distribution of braking force between the front and rear tires.

Brake Compound—The friction material used to manufacture the brake shoes or pads.

Braking Distance—The distance required to reduce the speed of a car between two points.

Bump Stop—A device used to limit the travel of a spring/damper to prevent the suspension system from reaching the end of its travel.

Camber—A measure of the tilt of a tire when viewed from the rear. Camber is used to adjust the tires so that the maximum tread is in contact with the ground while cornering.

Center of Gravity—A position within the vehicle where the theoretical mass of the car is centered. This is the point around which the car will rotate. Typically the center of gravity should be located between the tires and as low as possible.

Chicane—A short corner that is designed to reduce speed.

Damper—Used as an addition to a spring to dampen the recoil of the suspension. Dampers also increase the spring rate of a suspension based on how quickly they are compressed. Often referred to as a shock absorber.

Downforce—The force exerted downward. Downforce is generated through the weight of the car and through aerodynamic forces.

Drag—Resistance to motion. Typically refers to aerodynamic forces but can also include mechanical drag and rolling resistance.

Grip—Refers to the adhesive nature of tires on the road surface.

Ground Effect—A property of aerodynamics that uses the bottom of a car in close proximity to the ground as an inverted wing, causing the car to be drawn into the ground. Capable of generating tremendous grip.

Handling—Used to describe the turning properties of the car. Poor handling usually means that a car has excessive oversteer or understeer.

Horsepower—A unit of power equal to 33,000 foot lb. per minute of work.

Lollipop—Refers to the device marking/locating a pit position. It is typically a sign or symbol attached to a long pole that is held over the pit wall in front of the pit position.

Oversteer—Used to describe the tendency of the vehicle to lose grip at the rear of the car. Oversteer makes the car tend to spin.

Paddock—The parking area next to the pit where most of the work on the car takes place.

Points—Points are awarded while racing an entire circuit and are used to determine an overall winner at the end of the season.

Push—Term used to refer to *understeer*.

Refuel—The act of filling the fuel tank during a pit stop. Only the minimum amount of fuel should be used to minimize weight and optimize the acceleration.

Rev Limiter—A device attached to the engine to prevent over-revving and to limit the speed through the pit lane.

Ride Height—The height of the bottom of the car above the road surface.

Rolling Resistance—The natural drag produced by a tire rolling across the road surface.

Rumble Strip—The textured curbing at the edge of the road that is a warning to drivers that they are running on the edge of the track.

Slip Angle—The angle formed by the physical direction of the tire and the actual direction of travel.

Split Times—A measure of the time it takes to complete a segment of track rather than a whole lap. Segments are measured from the center of a corner to the center of the following corner.

Springs—A part of the suspension assembly that is used to support the car, absorb bumps, and control the amount of roll through a corner.

Steer Lock—A measure of the total swept angle through which the tires can turn.

Suspension Travel—The distance the suspension can move in relation to some fixed point.

Telemetry—Data that is collected by onboard computers and relayed to the pits in real-time.

Torque—Usually refers to the amount of twisting force produced by the engine and applied to the tires.

Traction—Refers to the amount of grip the rear wheels are capable of sustaining during acceleration and deceleration.

Traction Control—A system that monitors rear-tire slip and reduces power output to minimize tire slip and improve acceleration.

Understeer—Used to describe the tendency of a car to lose grip at the front tires first. This tendency causes the car to continue in a straight line instead of turning.

Wing—A device attached to the body of a vehicle that produces aerodynamic forces while the car is in motion. Wings are typically attached to the front and rear of the car.

SOFTWARE DEVELOPMENT CREDITS

Producer
Brent Erickson

Design
Brent Erickson
Shaun Mitchell

Programming
Guy Carver
Brent Erickson
Peter Sundholm

Additional Programming
Ken Houborg
Andy Taylor

Art Direction
Shaun Mitchell

Art and 3D Models
Chris Doll
Michael Matthews
Kelly Rains
Bart Rydalch

Track Construction
Michelle Buenzli
Michael Matthews
Bart Rydalch

Playtesting
Jim Barber
John Beck
Paul Benmussa
Steven Berra
Chris Boucher
Lowell Denning
William Dillon
Chris Doll
Randy Dugger
Bill Durney
Eric Eckstein
Mark Fezza
Paul Gittins
Gregory Hedges
John Herring
Steven Hillyer
Greg Hollaway
Pam Humphreys
Alexander Kalymon
Kurt Kemmling
Kevin Kitchens
Jim Pedicord
William Pepitone
Loring Rose
James Sablatura
David Syria
Paul Winner
Mike Zemina

Original Box and Manual
Jay Beale
Brent Erickson
Michael Matthews
Peggy Meile
Shaun Mitchell
Katey Springle
Casper Uhl

Pro-Pack Additions
Brent Erickson
Larry Atherton
Trent Noller

MAIL/FAX TECH SUPPORT

Please use this form (or a copy) to obtain technical support for XCar Pro from Motion Software, Inc. Fill out all applicable information about your system configuration and describe your problem as completely as possible. We will attempt to duplicate the problem and respond to your question as soon as possible. Mail or fax this form and any additional information to the number/address below. Note: We will only respond to problems from registered users—if you are not registered, please take a moment and fill-out and mail-in the registration card supplied with your software.

Your Phone ( ) _____-_____ Your Fax ( ) _____-_____

Your Name _____

Address _____ Apt. or Building _____

City _____ State _____ ZipCode _____

Brand of computer _____ CPU _____ Speed _____

Size of hard drive _____ Amt of RAM _____ Type of monitor _____

Brand and version of your sound card, video card, mouse, joystick, & CD-ROM:

_____

_____

Are you running Windows ❑—Yes ❑—No If yes, what version _____

If NOT running Win95/98, enter DOS version (type **VER** at DOS prompt)_____

Please describe the problem you encountered with **XCar Pro** and, if necessary, the menu choices, error messages, and/or other conditions that may be related to the problem:

_____

_____

_____

_____

_____

Were you able to duplicate the problem? _____

Other games run on this computer system: _____

Mail or fax this form to:

Motion Software, Inc., 535 W. Lambert, Bldg. E, Brea, CA 92821-3911
Web: www.motionsoftware.com; Email: support@motionsoftware.com; Fax: 714-255-7956

Motion Software, Inc.
535 West Lambert Road, Building "E"
Brea, California 92821-3911
Voice: 714-255-2931, Fax: 714-255-7956
Web: www.motionsoftware.com
Email: support@motionsoftware.com

XCar™ Developed By Bethesda Softworks™

Compatible With Motion-PC® & DeskTop Dyno Simulation Technology